IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

TULLIO L. DELIBERALI, Plaintiff, v. A.W. CHESTERTON, INC., et al. Defendants.	CIVIL ACTION NO. 2:18-cv-02682-ER

DECLARATION OF RANDALL M. GERMAN, PH.D.

Owens-Illinois, Inc. ("Owens-Illinois") submits the Declaration of Randall M. German, Ph.D. in support of its Notice of Removal.

Respectfully submitted,

MARON MARVEL BRADLEY ANDERSON & TARDY, LLC

By: /s/ Chad D. Mountain
Chad D. Mountain, Esquire

Date: June 28, 2018

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Counsel for Defendant Owens-Illinois, Inc.

DECLARATION OF RANDALL M. GERMAN, PH.D.

Randall M. German, Ph.D. declares as follows:

1. Attached is my curriculum vitae. I received my Ph.D. from University of California at Davis in 1975, Materials Science Option in Mechanical Engineering. I also hold an M.S. in Metallurgical Engineering and a B.S. in Materials Science. I am currently Research Professor of Mechanical Engineering at San Diego State University.

2. I specialize in the field of Materials Science, an interdisciplinary field that focuses on the discovery and design of new materials. Throughout my career, I have conducted research and engaged in consulting on various materials science topics. I have received numerous grants to perform research regarding materials science issues. I hold twenty-five patents and have authored hundreds of articles in peer-reviewed publications on materials science issues.

3. Materials science and engineering is the study of the properties and performance of various materials, including their atomic structure, composition, microstructure, and how the properties and performance of materials are affected by processing actions, such as amount of time, temperature, pressure, and heating rate.

4. I have reviewed and analyzed numerous documents regarding the development and testing of Kaylo pipe covering and block, the asbestos-containing insulation products manufactured by Owens-Illinois, Inc. ("O-I"). These have included

patents; United States Navy specifications, documents, and correspondence; and O-I technical reports, records and reports, advertisements, among other things.

5. Kaylo pipe covering and block were high-temperature thermal insulation materials produced by O-I in the 1940s and 1950s, until O-I sold its Kaylo division to Owens Corning Fiberglas ("OCF") on April 30, 1958. These were light-weight, hydrous calcium silicate insulation products, made of calcium oxide (lime), silicon oxide (sand), water, and asbestos fibers.

6. O-I designed and developed Kaylo pipe covering and block insulation to meet the precise specifications and standards for thermal insulation formulated by the United States Navy. The records of O-I's development of Kaylo in the early 1940s (during World War II) demonstrate the company's efforts to meet the United States Navy specifications. For example, in 1942, U.E. Bowes, O-I's director of research, reported that the experimental product, "when tested by the U.S. Navy specifications for Class A insulation, for use up to 500° F., and Class B, from 500° F. to 1000° F., passed on all points . . . ." *See* Proposal to Purchase Equipment and Facilities for Increased Production of Microporite at 1, Nov. 13, 1942.[1]

7. O-I's efforts to comply with Navy specifications continued throughout the development and manufacture of United States Kaylo pipe covering and block

[1] "Microporite" was the name given to what would later become Kaylo, in its early stages of development.

insulation. For instance, a 1952 report prepared by O-I's General Research Division indicates that Kaylo was subjected to – and passed – the "hardness and abrasion tests described in Navy Department specifications for Thermal Block Insulation No. 32-I-3, Dec. 1, 1943." *See* Hydrous Calcium Silicates, Part V: Physical and Chemical Properties of Kaylo Products at 6 (General Research Division, Owens-Illinois Glass Company, Oct. 31, 1952). The report further stated that Kaylo met the maximum linear shrinkage standards described in United States Navy Department Specifications 32P8d, Aug. 2, 1948 for pipe insulation. *See id.* at 11. *See also* Chemical and Physical Properties of Commercial Thermal Insulation, Project 83.1, Properties of Kaylo Thermal Insulation and Competitive Materials at 6 (General Research Division, Owens-Illinois Glass Company, Mar. 25, 1955) (discussing testing of Kaylo for modulus of rupture "based on Navy Department Specification 32 P8d, August 8, 1948").

8. Similarly, a 1957 General Research Division progress report discussed changes made to the formulation of "Kaylo 20" (a higher-temperature variant of Kaylo then under development) in order to "enable the material to pass the Navy specifications . . . ." *See* Progress Report, General Research Division, First Quarter, 1957 at 60 (Apr. 5, 1957). The progress report stated that "[a]fter the plant has made Kaylo 20 from a recommended formulation, samples of flat ware will be sent to the Navy for re-evaluation . . . ." *Id.* Thus, Kaylo pipe covering and block insulation was developed on

the basis of involved judgments made by the military, and manufactured with the special needs and specifications of the military in mind.

9. The United States Navy specifications which Kaylo pipe covering and block insulation were designed to meet were detailed and precise, and the United States Navy conducted engineering experiments and approved Owens-Illinois Kaylo block and pipe covering pursuant to those specifications. *See* U.S. Navy correspondence, January 12, 1944; U.S. Navy correspondence, May 29, 1944. The certificate of approval of Kaylo specifically states: "NAVY SPECIFICATIONS: This approval is based upon material in strict accordance with the governing Navy Department specification, and nothing in connection with this approval shall be construed as a waiver of any part of the governing specifications." The United States Naval Engineering Experiment Station test report on Kaylo describes the testing done to determine whether Kaylo block material met the specifications for different classes of block material. Those tests included chemical analyses (including determining how much asbestos was used in the material), physical properties, and thermal conductivity.

10. The United States Navy specified design features (e.g., the dimensions and shape of the insulation, and the materials used for packaging) and required products to undergo extensive testing to ensure certain levels of density, stability (the ability to resist shock and vibration), thermal conductivity, hardness, resistance to abrasion, modulus of rupture (the ability to resist breakage under pressure), loss in

weight and linear shrinkage under heat, and moisture absorption. *See* U.S. Navy Department Specifications MIL-P-2781-E - 32P8(INT), Pipe-Covering, Thermal-Insulation; U.S. Navy Department Specifications MIL-I-2819-F - 32-I-3(INT), Insulation, Thermal, Block.

11. In order to comply with United States Navy specifications, O-I subjected Kaylo pipe covering and block insulation to a battery of tests, many of them specifically set forth in the United States Navy specifications themselves. O-I's testing of Kaylo included the following:

a. Thermal conductivity test: This test measured the extent to which heat moves through the material. A heat source is applied to one side of the material, and the technician observes the temperature rise on the other side. The measurements include the thickness of the material, its area, the temperature difference between the "hot" and "cold" sides, and the time over which the temperature rises. *See* U.S. Navy Department Specification 32-I-3, Dec. 1, 1943 at 2, ¶ F-3a(2).

b. Strength test/Hinging test: This test assessed the ability of the material to fracture without separation. A piece of material was placed on two support rods, and a third rod was used to apply pressure on the opposite side, while measuring the peak amount of

pressure applied. After the material fractured (but did not separate entirely into two pieces), it was turned over, and the peak pressure to bend it in reverse was measured. The ratio of the amount of pressure applied in the second stage as a ratio to the amount applied in the first stage was calculated, and this was known as the hinging value (usually expressed as a percentage).

c. Drop test: This test measured the material's resistance to fragmentation on gravity-induced impact. Initially, the test involved attaching a piece of steel to the bottom of the material and dropping it on a flat surface from varying heights (increasing in one-inch increments) to determine the peak drop distance at which the material would not fracture. A simpler but similar result could be achieved by sliding the material off a tabletop, and seeing how many times this could be done before a piece of the material broke off.

d. Tumbling test (a.k.a. "abrasion" test): This test involved placing twelve one-inch cubes of the material into a wooden box with twenty-four wooden cubes, and quickly rotating the box for two ten-minute periods. The technician would then measure the amount of material that broke off the cubes as a result of the

"tumbling." This test was specifically set forth in the Navy specifications. *See* U.S. Navy Department Specification 32-I-3, Dec. 1, 1943 at 3, ¶ F-3a(5).

e. Shrinkage test: This test, also known as the "hot pipe" test, measured the ability of the material to retain its dimensions after exposure to heat. Pieces of material would be placed inside ovens heated to various temperatures for six hours (initially), after which the technician measured changes in the length, width, and thickness of the material. In order to pass the test, the change in each dimension had to be less than 2%. This was another test specifically outlined in the Navy specifications. *See* U.S. Navy Department Specification 32-I-3, Dec. 1, 1943 at 3, ¶ F-3a(6).

f. Lightweight/density test: This test simply divided the weight of the material by its volume to determine its density. A low density was desired. This was yet another test specifically provided in the Navy specifications. *See* U.S. Navy Department Specification 32-I-3, Dec. 1, 1943 at 4, ¶ F-3a(9).

g. Hardness test: This test involved pressing a metal ball into the material with a certain amount of weight, and measuring how far into the material the ball would penetrate. This was another test

specifically set forth in the Navy specifications. *See* U.S. Navy Department Specification 32-I-3, Dec. 1, 1943 at 3, ¶ F-3a(4).

12. Because of problems with availability and regularity of the supply of asbestos, and because that asbestos was the most expensive raw ingredient of Kaylo, O-I experimented with various substitutes for the material. These included fiberglass; bagasse (fibers left over after sugarcane is crushed to extract its juice); natural fibers such as wool, cotton, redwood, goat hair, and mattress filling; newspaper; Kraft paper; pulp; mineral wool; metal wires such as copper and steel; ceramic fibers such as alumina and silica; and polymer fibers such as nylon and rayon.

13. However, the requirements of the United States Navy specifications for high-temperature thermal insulation could not be met, in the 1940s and 1950s, without the use of asbestos because none of the substitute materials met each of the requirements in the United States Navy specifications. While some materials met some of the requirements, none successfully passed the full battery of tests. For example, fibers like redwood and bagasse change size based on water exposure. This hindered them from bonding so they did not provide the necessary strength to pass the hinging test. These fibers could also burn at high temperatures. Fiberglass would dissolve upon contact with hot alkali (calcium). Other fibers allowed the water to separate from the mix, often leaking out of the mold during the fabrication process, causing a high

density. Only asbestos yielded the necessary degree of strength, bonding, hardness, low density, and heat conductivity.

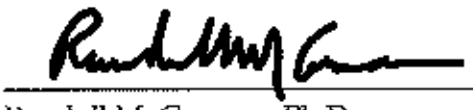
14. Thus, asbestos was a necessary component in light density high temperature thermal insulation as specified by the United States Navy in the 1940s and 1950s. Moreover, because the Kaylo approved by the United States Navy pursuant to its specifications contained asbestos, even if O-I had been able to find a material that worked as a substitute for asbestos, it could not have provided a non-asbestos Kaylo to the United States Navy without subjecting that non-asbestos material to United States Navy testing, meeting the United States Navy specifications, and obtaining United States Navy approval.

15. The search for a viable asbestos substitute in Kaylo continued for many years after O-I sold the Kaylo business to OCF in 1958. Various materials were tested unsuccessfully. Finally, in November of 1972, after extensive research, OCF was able to replace asbestos in Kaylo with a combination of cellulose as the thickening agent and newly-invented zirconia fiberglass specially coated with poly vinyl acetate (to make it alkali-resistant) as the dispersing agent. This required changes to the fabrication process, including adding aluminum sulfate salt to accelerate gelation, an additional pre-heating step prior to placing the slurry into an autoclave, and a higher autoclave temperature. The processes and materials required to make asbestos-free Kaylo pipe

covering and block insulation that would meet the Navy specifications were not available during the time O-I manufactured Kaylo.

16. This declaration summarizes work performed to date and presents my findings and opinions resulting from that work. I reserve the right to supplement this declaration and to expand or modify any of my opinions based on analysis of additional material as it becomes available or is reviewed.

I declare under penalty of law that the foregoing is true and correct. Executed on 27 February 2018.

By: 

Randall M. German, Ph.D.

Randall M. German

Research Professor, Emeritus Professor
Mechanical Engineering, San Diego State University
[Emeritus Professor of Engineering, Pennsylvania State University]

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Research Interests

Materials processing; particulate materials, powder consolidation, sintering, microstructure evolution, powder metallurgy, advanced ceramics, powder injection molding, additive manufacturing and rapid prototyping, particulate composites.

Education

B.S., 1968, San Jose State University, Materials Science (Honors, Magna Cum Laude)
M.S., 1971, The Ohio State University, Metallurgical Engineering
Ph.D., 1975, The University of California - Davis, Materials Science Option in Mechanical Engineering
Certificate, 1979, Hartford Graduate Center, Industrial Management Development
Certificate, 2008, Harvard Graduate School of Education, Institute for Higher Education Management Development.

Professional Career

1967, 1968-1969 Materials Scientist, Powder Metallurgy Division, Battelle Columbus Laboratories, Columbus, Ohio
1969-1977 Member Technical Staff, Metallurgy Division, Sandia National Laboratories, Livermore, California
1977-1978 Director of Research and Development, Mott Metallurgical Corp., Farmington, Connecticut
1978-1980 Director of Research, J. M. Ney Co., Bloomfield, Connecticut
1980-1985 Associate Professor, 1985-1988 Professor, and 1988-1992 Robert Hunt Professor, Materials Engineering Department, Rensselaer Polytechnic Institute, Troy, New York
1991-2006 Brush Chair Professor in Materials, 2006-on Emeritus Professor, Engineering Science and Mechanics Department; 2000-2006 Director, Center for Innovative Sintered Products, Pennsylvania State University, State College, Pennsylvania
2005-2008 CAVS Chair Professor in Mechanical Engineering and Director, Center for Advanced Vehicular Systems, Mississippi State University, Starkville, Mississippi
2008-2016 Professor of Mechanical Engineering [Adjunct-Research-Emeritus Professor 2016-on], 2008-2013 Associate Dean Engineering, San Diego State University, San Diego, California

Honors and Awards

educational

Science Medal and Mathematics Medal, California State Scholar, Owens Corning Scholarship in Engineering (twice), Presidential Scholar (San Jose State), Dean's Scholar (four times), San Jose State University Scholarship (four times), American Society for Metals Scholarship, Bank of America Award in Mathematics, American Society for Testing Materials Award, Tau Beta Pi Engineering Honor Society, Phi Eta Sigma honor society, Tau Delta Phi honor society, Northwestern University National Science Foundation Fellowship.

professional

Honorary Doctorate - Doctor *Honoris Causa* - Universidad Carlos III de Madrid
Fellow of the American Ceramic Society
Fellow of the American Society for Metals (ASM International)
Fellow of the American Powder Metallurgy Institute (APMI International)
Tesla Medal in Physical Sciences, Nikola Tesla Foundation
The Minerals, Metals and Materials Society – "Randall M. German Honorary Symposium" 141st Annual Meeting
University of California Davis Distinguished Engineering Alumni Award
San Jose State University Award of Distinction
Ohio State University Distinguished Alumnus Award
Alpha Sigma Um Honorary Member
International Team for the Science of Sintering – Elected Full Member
Alfred H. Geisler Award Outstanding Young Metallurgist - Eastern New York ASM
Ralph R. Teetor Engineering Educator Award of the Society of Automotive Engineers
Rensselear Polytechnic Institute Faculty Early Career Award
Honorary Professor of Northeast University of Technology (Shenyang, China)
Samsonov Prize, International Team for the Science of Sintering
Faculty Partner Award Center for Manufacturing Productivity and Technology Transfer
Metal Powder Industries Federation Distinguished Service Award
Nanyang Professor Appointment, Nanyang Technological University, Singapore
Kuczynski Prize, International Institute for the Science of Sintering
Japan Institute of Metals Technical Development Award
Penn State University Engineering Society Outstanding Research Award
Metal Powder Report Award for Promotion/Education
Penn State University Engineering Society Premiere Research Award
Honorary Member Korean Powder Metallurgy Institute
Powder Metallurgy Association of South Africa Honorary Life Membership
Sauver Lecture Award ASM International
Distinguished Lecture Award from the Japan Research Institute of Materials Technology
Distinguished Achievement in Research Award from Japan Society for Powder Metallurgy
Santander Visiting Professor at Universidad Internacional Menendez Pelayo, Spain
Institute of Materials, Minerals and Mining Best Paper Prize
Plenary Lecture Korean Powder Metallurgy Institute
Best Paper Award Materials-Energy-Environment Conference, Korea
Innovation Bronze Medal, Malaysia Technology Expo
First Prize, China Machine Press, with Jiupeng Song
Turkish Academy of the Sciences, Publication Recognition Award with Ozkan Gulsoy

Other Professional Awards - Microstructural Analysis Society, International Metallographic Exhibit (three times), Powder Metallurgy Technology Metallographic Award (several), Outstanding Young Men of America, *Who's Who in Engineering*, *Who's Who in Frontier Science and Technology*, Key Professor in the Center for Powder Metallurgy Technology, *Who's Who in America*, *Who's Who in Science and Engineering*, Best Paper Award from Metal Powder Industries Federation, *Who's Who in American Education*, *Science Citations* "Highly Cited" in Materials Science

Professional Activities

Society Membership -

American Ceramic Society - Fellow
APMI International (American Powder Metallurgy Institute) - Fellow
ASM International (American Society for Metals) - Fellow
International Team for the Science of Sintering (Full Member)
Korean Powder Metallurgy Institute (Honorary Life Member)
Metal Powder Industries Federation (Consulting Member)
South African Powder Metallurgy Association (Honorary Life Member)
The Minerals, Metals and Materials Society (AIME)
prior memberships - Society of Automotive Engineers, Materials Research Society, American Society of Mechanical Engineers, Society of Manufacturing Engineers, Society of Plastics Engineers, American Society for Engineering Education, European Powder Metallurgy Association, Japan Society for Powder Metallurgy, Society for Advanced Material and Process Engineers

Citations -

Business Week, Metal Powder Report, Advanced Materials and Processes, International Journal of Powder Metallurgy, Metal Powder Industries Federation, Journal of the Korean Powder Metallurgy Institute, Journal of the Japan Society for Powder and Powder Metallurgy, Journal of the Japan Institute of Metals, Automotive Industries, Institute of Metals-Materials-Minerals, Malaysia Technology Expo, Journal of Metals, Ceramic Bulletin, Powder Injection Moulding International, Powder Metallurgy Reviews

Leadership Positions -

The Metallurgical Society American Institute of Mining, Metallurgical, and Petroleum Engineers The Minerals, Metals and Materials Society (TMS) – Powder Metallurgy Committee Vice-Chairman (1977-1979), Chairman (1981-1983), Program Chairman (1981); Editorial Advisory Committee for *Journal of Metals*; Editorial Review Board *Metallurgical Transactions A*; Hudson-Mohawk Section Membership Chairman (1981-1982), Education Chairman (1982-1983), Treasurer (1983-1984), Vice Chairman (1984-1985), Chairman (1985-1986), Symposium Chairman (1983), Distinguished Career Award Chairman (1986-1987)

ASM International – Powder Metallurgy Committee (since 1987); Eastern New York Chapter Executive Committee and Membership Chairman (1980-1982), Fellows Selection Committee (1992-1996); Near-Net Shape Program Committee (1992-1994), *Fracture and Fatigue* Handbook Committee (1995-1996), *Powder Metallurgy* planning committee and co-editor (1996-2000), Program Organizer for Materials Week (2001), *Computer Modeling* Handbook Committee (2007-2012), *Powder Metallurgy Handbook* (2013-on)

American Ceramic Society – Program Organizer for Basic Science Division (1981), invited speaker at Annual Meeting (1991, 1998, 1999), Pennsylvania Ceramic Association invited speaker (2000), Co-Organizer American Ceramic Society Pacific Rim Meeting (2007), Program Committee Sintering 08, Keynote Speaker Sintering 2017

APMI International and Metal Powder Industries Federation – Program Committees for 1983, 1986, 2000 National Conferences and 1984, 1986, 1988, 1992, and 1996 International Conferences; Chairman Editorial Advisory Committee (1984-1987); International Liaison Committee (1988 on); International Liaison Committee for PM '90; Judge for the 1988 International Part of the Year Award; Long-Range Planning Board (1989); Co-Chairman Powder Injection Molding Symposium (1990, 1991, 1992, 1993, 1995, 1996, 1997); Co-Chairman 1992 World Powder Metallurgy Congress, Board of Directors (1994-1997), Council of Fellows (1998-2001), Program Committee PM 2008, Program Committee Seventh International Conference on Tungsten, Refractory, and Hardmetals (2011, 2014), Chairman Workshop on Powder Injection Molding of Microminiature Devices (2009), Program Committee PM 2010, Program Committee 2014 World Congress, Program Committee Powdertech2015, Program Committee Powdertech2017

European Powder Metallurgy Association / Institute of Materials – Organization Committee for International Conference on Refractory and Hard Metals (2002), Technical Program Committee P/M 2004, Organizing Committee for Korean Powder Metallurgy Institute P/M 2006, Session Chair PM2010 World Congress

Plansee Seminar – Program Committee 17th Plansee Seminar, International Conference on High Performance PM Materials, Program Committee 18th Plansee Seminar, Program Committee 19th Plansee Seminar

International Institute for the Science of Sintering – Program Committee, International Advisory Committee, International Program Committee VII World Round Table Conference (1989), International Program Committee X World Round Table Conference (2002), Conference Co-Chairman *Sintering 1995*, Conference Co-Chairman *Sintering 2003*, Regional Editor *Science of Sintering.*

Particulate Materials Center at Penn State – Technical Director (1991-1994), Program Chairman P/M Processing Fundamentals (1994), Program Chairman Engineering Challenges Conference (1994), Organizer and Program Co-Chair for Sintering Conferences (1993, 1997, 2001).

Center for Innovative Sintered Products – Founder and Director (1991 - 2006), Conference Co-Chairman for *Sintering 95* Conference (1995), Conference Co-Chairman for *Sintering 99 Conference* (1999), Conference Co-Chairman *Sintering 03* (2003), Chairman PIM Workshop (1995-1999), Conference Co-Chairman for PIM 92 (1992), PIM 94 (1994), PIM 95 (1995), PIM 96 (1996), PIM 97 (1997), PIM 98 (1998), PIM 99 (1999), PIM 2000, PIM 2001, PIM 2002, PIM 2003, PIM 2004, PIM 2005, PIM 2006, Organizer Ferrous Powder Metallurgy Course (2000, 2001, 2002), Organizer Sintering Concepts Course (2001, 2002, 2003).

National Aeronautics and Space Administration (NASA) –Investigator Working Group IML-2 (1991-1996), Chairman Microgravity Review Panel (1992), Chairman Science Concept Review for Solid-Liquid Coarsening (1994 and 1996), Panel Review Chairman Metals and Alloys (1999).

Director and Advisor Positions

Newmet Tubular Products, Inc. - Board of Directors (1978-1981), Newmet Products, Inc. - Board of Directors (1981-1985), Xform, Inc. - Board of Directors (1988-1995), Penn State Materials Research Institute - Board of Directors (1991-2005), Thermat, Inc. - Board of Directors (1991-1995), APMI International - Board of Directors (1994-1997), Innovative Material Solutions, Inc. - Board of Directors (1995-1999), Klinair Environmental Technology, Ltd. - Board of Directors (1996-1999), InfoCent, Inc. - President (1997-2001), Aesthetic Materials - Board of Directors (1998-2002), PowderTech, Inc. - Board of Directors (1998-1999), T & R Technology, Inc. - Board of Directors (1998-2000), Allomet - Board of Directors (1999-2014), Advanced Materials Technologies, Pte. Ltd. - Board of Directors (2000-2003), Austrian Research Centers in North America - Technical Advisory Board (2002-2004), AMTellect - President and Board of Directors (2002-2003), ATI Metalworking Products - Advisory Board (2003-2007), Pangaea Ventures Fund I, Fund II, and Fund III – Technical Advisory Board (2003-on), International Nontoxic Composites - Board of Directors (2005-2008), High Performance Computing Collaboratory Operations Board (2005-2008), Amulaire Thermal Technology - Technical Advisory Board (2006-2008), Madrid Institute for Advanced Study IMDEA (2009-2015), Springfield Munitions – Board of Directors (2008-2010).

Advisory, Panel, Reviewer, or Editorial Roles

Reviews in Particulate Materials (Editor), *P/M Science and Technology* Briefs (Editor), *Powder Injection Moulding International* (consulting editor), Wiley Interscience (Series Editor, Consulting Editor, reviewer), *International Journal of Powder Metallurgy* (Editorial Advisory Committee, Chairman Publications Committee, Chairman International Liaison, Guest Editor, reviewer), *Powder Metallurgy* (editorial board, reviewer), *Metallurgical and Materials Transactions* (key reader, reviewer), *Science of Sintering* (regional editor, reviewer), *Powder Technology* (guest editor, reviewer),National Academies Review Panel on Unit Manufacturing Processes, National Aeronautics and Space Administration (program panel chair), *Industrial Heating* (editorial advisory panel), *Journal of the American Ceramic Society* (reviewer), National Science Foundation (reviewer, panel member), *Journal of Applied Physics* (reviewer), *Applied Physics Letters* (reviewer), U. S. Army Research Office (reviewer), *Scripta Materialia* (reviewer), Department of Energy (reviewer), Research Council of Canada (reviewer), *Chemical Engineering Science* (reviewer), *Particulate Science and Technology* (reviewer), *Materials Science and Engineering* (reviewer), *Journal of Metals* (topical Editor, reviewer), *Journal of Engineering Materials and Technology* (reviewer), *Metals Handbook* (Editor, reviewer), MacMillian Publishing Co. (reviewer), American Society of Mechanical Engineers (reviewer), *Journal of Materials Synthesis and Processing* (reviewer), National Research Council (panel member), *Journal of Materials Science* (reviewer), Marcel Dekker (editor, reviewer), *Canadian Metallurgical Quarterly* (reviewer), *Corrosion Science* (reviewer), *Intermetallics* (reviewer, editorial committee, key reader), SUSTAIN (reviewer), *Acta Materialia* (reviewer), *International Journal of Refractory Metals and Hard Materials* (reviewer), California Energy Research Foundation (reviewer), *Journal of Advanced Materials* (editorial panel), *International Journal of Mechanical Sciences* (reviewer), Australian Nuclear Science and Technology Organization (external reviewer), *Nuclear Engineering and Design* (reviewer) Nanyang Technological University (thesis reviewer, external tenure reviewer, contract renewal reviewer), Air Force Research Laboratory, Edwards Air Force Base (external reviewer), National Academies Review Panel on Weapons and Materials at Army Research Laboratory, Doctoral Thesis Reviewer

University College Dublin, *Advanced Powder Technology* (reviewer), *Finite Elements in Analysis and Design* (reviewer), *Thermochimica Acta* (reviewer), *Journal of the European Ceramic Society* (reviewer) Society of Manufacturing Engineers (training).

Academic Duties

departmental committees

Honors and Awards, Graduate Research Allocation Board, Curriculum, Faculty Search (chairman 1984-1988), Library Representative (1980-1991), Long Range Planning (1989-1990), Engineered Materials Minor (1991-1997), Candidacy Committee (1992-1998), Judicial Committee (1994-1995), Department Retreat Committee (1995-1996), Promotion and Tenure Committee (1995-1997, 2004-2005), Fellon Award Committee (1995-2003), Institute of Mechanics and Materials (1996-1998), Department Chairman Search Committee (2001-2002), Strategic Planning Committee (chairman 2003-2005), Graduate Committee (2005-on), Curriculum Committee (2008-2012), Computer Policy Committee (2008-2012).

campus committees

Library Advisory (chairman-1985 & 1986), Director of the Libraries Search (1984), School of Engineering Promotion and Tenure (1988-1989), Faculty Council Promotion and Tenure (1989-1991), Center for Manufacturing Productivity and Technology Transfer Advisory Committee (1986-1991), Materials Research Institute Board of Directors (1991-2005), College of Engineering Manufacturing Research Committee (1992-1994), College of Engineering Faculty Promotion and Tenure Committee (1992-1993), Honorary Degree Committee (1993-1995), Chairman of the Pugh Chair Selection Committee (1994-1996), Research Contract Procedures Committee (1996), Engineering Research Center (1998-2006), Faculty Scholar Medal Committee (2001-2004), CAVS Chair III Search Committee (Chairman 2005-2008), High Performance Computing Operations Board (2005-2008), Giles Distinguished Professor Selection Committee (2006-2007), Engineering Outreach Committee (2006-2008), Dean's Budget Advisory Committee (chairman, 2008-2009), Computer Planning Committee (member, 2008-on), California Space Grant Consortium (representative, 2008-on), Graduate and Research Committee (2008-on), Vice President for Research search (2011-2012).

teaching

Elements of Materials Engineering (undergraduate introductory course), Powder Metallurgy (senior-graduate level elective), Physical Metallurgy (junior level required course), Computer Experiments in Materials Engineering (senior-graduate level elective), Powders and Sintering (graduate level special topics course), Materials Characterization (junior level elective), Mechanical Response of Engineering Materials (junior level required course), Particulate Materials Processing (senior-graduate elective), Sintering Processes (graduate elective), Mechanical Behavior of Materials (graduate required course), Strength Design of Engineering Materials (senior elective), Sintering Theory and Practice (graduate elective), Materials Science for Engineers (junior level required course), Rheology of Loaded Suspensions (graduate elective course), Powder Injection Molding Design (elective senior-graduate course), Engineering Design of Mechanical Components (junior level required course), Particulate Composites Engineering (elective senior and graduate course).

graduate advising

34 PhD, 71 MS, and 9 BS (honors) theses completed under my direction.

Consulting Activities

Newmet Products (Board of Directors and Technical Advisory Board) (1978-1984), International Business Machines (1980), Lawrence Livermore National Laboratory (1980-1987), Special Metals Corp. (1980-1983), Harstan Chemical Corp. (1981), Interlek Inc. (1981-1982), Alcan Ingots and Powders (1982-1988), Bendix Friction Products Division (1983), Battelle Columbus Laboratories (1983-1989), General Instrument (1983-1986), Glyco (1983-1986), Leach and Garner (1984-1988), Blasch Precision Ceramics (1984), Guyson USA (1984), Newark Wire Cloth (1984), Crucible Research Center (1984), Hittman Materials and Medical Components (1984), Newmet Krebsoge (1984-1991), Ashot-Ashkelon Industries (1985-1988), Process Equipment (1984-1985), Metadyne Inc. (1985-1990), Federal Mogul (1985), Kodak (1985), Williams Gold Refining (1985-1986), Alloy Technology International (1985-1987), Denpac (1985-1990), Micro Mirror (1986), Brake Systems (1986), Micro Materials Technology (1986-1988), Cabot Performance Materials (1985-1998), Texas Instruments (1986-1989), Air Products and Chemicals (1986-1987, 1995-1998), Materials Research (1986-1992), Lynch, Sherman and Cox (1986-1987), Fine Particle Technology (1986-1988), Alcoa (1986-1989, 2005), Automated Dynamics (1987-1990), Esco (1987), Kennametal (1988, 1997, 2009-2012), Longyear (1988-1991), Olin Metals Research (1988), UNC Naval Products (1988), Gates Energy Products (1988), General Electric (1988-2004), Five Star Alloys (1988-1989), Corning (1988, 1992-1998, 2006), CMP (1988-1990), Gorham Advanced Materials Institute (1988-1991), Margolin Associates (1988), New York State Science and Technology Foundation (1988-1990), Ferraloy (1988-1989), Boart International (1988-1992), Ceramics Process Systems (1988-1992), Southwest Research Institute (1989-1992), Korea Agency for Defense Development (1989), General Motors (1989-1991), Phoenix Metals (1989), Knolls Atomic Power Laboratory (1989-1991), HJE (1989-1992), Union Carbide (1989), Xform (1990-1997), Tyrolit (1990-1997), Luigisavio (1990), Squire, Sanders and Dempsey (1990), Remington Arms (1990-1996), IMMP Blount (1990-1992), GAF (1990-1991), Technetics (1990-1991), Unitek/3M (1990), J. M. Ney (1990), Etcon (1990-1993), Patec (1991-1993), J. F. Jelenko (1991), Precision Castparts (1991), Sherwood Refractories (1991-1994), AT&T (1991-1992), Witec (1991-1995), Pennsylvania Department of Commerce (1991), Toranaga Technologies (1992-1994), B. F. Goodrich (1992), Windfall Products (1992), Alpha Sintered Metals (1992), Comalco (1991-1997), Diamond Products (1992), Stackpole (1992), Upchurch Scientific (1992-1997), DTM (1993-1995, 1999), Mold Masters (1992), Delco Remy (1992-1995), Ceracon (1992), Elkem (1994-1998), Cutler-Hammer (1994-1995), Ametek (1994-1999), Litton Electron Devices (1994-1995), Metal Powder Industries Federation (1994-on) Amoco (1994-1995), Smith International (1995-1999), Howmet (1994-1996), Kemet (1995-1996), Klinair Environmental Technologies (1995-1998), Metal Powders Inc. (1994-1997), Praxair (1995), McDonnell Douglas (1995), Bowles Fluidics (1995), Carter Technologies (1995), Rockwell International (1995-1996), Metals Experts (1995), Department of Justice (1996), Kevin Kennedy and Associates (1995-2000), Mott (1995-1998), Carmody and Torrance (1996), MER (1994-1998), Zimmer (1995-1997), Dorsey and Whitney (1996), Bausch and Lomb (1996-1999), A&R Materials (1996), Electro-Tec (1996-1997), Ferro (1996-1997), Rohm and Haas (1996), SECO Tools (1996-1997), National Electric Carbon (1996-1997), Illinois Superconductor (1996), John Wiley (1996-on), Superior Graphite (1996-1997), Brush-Wellman (1996-2000), Isonics (1996-1997), Innovative Material Solutions (1996-2006), Benchmark (1997), Society of Manufacturing Engineers (1997-2001, 2013-2014), Hale and Dorr (1996-1998), Veeco Instruments (1997), Dean and Associates (1997), Intech Stainless Steel (1996-1997), Hoeganaes (1997), McCann's Engineering (1997), Boston Scientific (1997-1999), Metabolix (1997), Stoner Chemical (1997), Planet Polymer

(1998-2001), Union Miniere (1997-2000), Micropump (1998), Amercord (1997-1998), Brush Industries (1997-1998), Ennex Fabrication Technologies (1998), Kemp Development (1997-1998), EnDurAloy (1998-2003), Kilpatrick Stockton (1998), Furon (1998), Elopak (1998-1999), Parmatech (1999), Cummins Engines (1999), Praxair (1999), Whirlpool (1999), Brownstein Hyatt & Farber (1999-2000), Iscar (1998-1999), Never Compromise (1998-1999), Product Research and Development (1998), Ceracon (1999), GE Superabrasives (1999), Carpenter Technologies (1999), Globe Metallurgical Sales (1999), GKN Sinter Metals (1999-2002), Novamold (1999), Injectamax (1999-2000), Phillip Morris (2000), ESAB Welding (2000), Danly (2000-2005), Ridge Tools (2000), Implex (2000-2002), ViaMedics (2000), Harness, Dickey and Pierce (2000), Alcoa (2000), Apex PM Binders (2000), Emerson Advanced Materials Center (2000), GE Plastics (2001), Advanced Materials Technologies (2000-2003), Fish and Richardson (2001-2002), Quebec Metal Powders (2001), O'Hagan, Smith and Amundsen (2001-2002), Chrysalis Technologies (2000-2002), Atofina Chemicals (2001), Emrich and Dithmar (2002), Allomet (2002-on), Synergy Innovations (2002), Pfizer (2002), Chapin Manufacturing (2002-2003), Pall (2002-2003), Stevens and Lee (2003), Akin, Gump, Strauss, Hauer and Feld (2003), Dow Chemical (2003), Hewlett Packard (2003-2004), Heller Ehrman (2002-2003), South African Powder Metallurgy Association (2003), San Diego State Foundation (2003), Manufacturing Technologies (2003), Vapore (2003-2004), Borg-Warner (2003), National University of Singapore (2003), Nanyang Technological University (2003-2008), Allegheny Technologies (2003-2007), Cabot Performance Materials (2003-2004), Wendt-Dunnington (2004), US Civilian R&D Foundation (2004), Lonza (2004), Engelhard (2004), Stryker Orthopaedics (2004-2007), Pitney, Hardin, Kipp & Szuch (2004), Tyco Electronics (2004), WTP (2004), Robert Bosch (2004), ATI Alldyne (2003-2006), Remington Arms (2004-2005), Siemens (2005-2006), Cummins Power Generation (2006-2008), Amulaire Thermal Technologies (2006), Firth Sterling (2007), Bailey and Myers (2007-2010), GKN Sinter Metals (2007), Elsevier (2007), Inovar Communications (2007-on), Firelight Glass (2007), International Nontoxic Composites (2007), Cookson Electronics (2007), Kingfish Group (2007-2008), Ceradyne (2007), Nissan North America (2007), Heraeus (2007-2008), Webb Law (2007-2009), Mueller Industries (2008), Stork Metallurgical (2008), MicroPorous Plastics (2008-2010), LEK Consulting (2008), Kinetics (2008, 2012), Portugal Technological Center for Glass and Ceramic Industries (2008), Storm LLC (2008-on), Tungsten Heavy Powders (2008-2012), Cristal Global (2009), Maetta Science (2009-2015), Yuelong Superfine (2009-2101), Ortho Organizers (2009), Becton Dickinson (2009), TekForm Management (2009), University College Dublin (2009-2012), Austrian Institute of Technology (2009), Hanwoo Metallurgical Solutions (2009), Air Force Research Laboratory (2009), Space Charge (2009-2010), American Ceramic Society (2009-2010), Ultra-Infiltrant (2010-2012), Raymor Advanced Powders and Chemicals (2010), Lawrence Livermore National Laboratory (2010), Dynacast (2010), Polymer Technologies (2010-2011), Hoganaes (2010-2011), Beijing Jarain PIM Technology (2010-on), Brennan, Manna and Diamond LLC (2010), DuPuy Orthopaedics (2010), Steelinject Lupatech Metallurgy (2010), Pangaea Ventures (2011-on), Element Six (2010-2013), Hoganaes Sweden (2010-2011), Argen (2008-2017), ASH Industries (2011-2014), Fonds FQT (2011), Delphi (2011-2012), Bushnell (2012), Orton Foundation (2011-2012), Pohang University of Science and Technology (2012-on), Bechtel Hanford Waste Treatment (2012), Kennametal Business Development (2012), Henkel Electronics (2011-2013), Smith Metal Products (2012), Meyers Sintermetall (2012-2014), Kinetics Climax (2012), Allegheny Technologies Allvac (2012), Cardica (2011-2013), Alston Bird (2012-2013), McElroy, Deutsch, Mulvaney & Carpenter, LLP (2012-on), Dow Chemical (2013), Dupont (2013-on), Harscor International (2013), Global Titanium (2013), Nanyang Technological University (2013), Innomet Powders (2013-2017), Poonsang (2013), Freundenberg (2014), Teklicon (2014-on), Praxair (2014-2015), Phenomenex (2013-2014), Society of Manufacturing Engineers (2014), Saint Gobain (2014), Heraeus (2015), Liquid Metal -

Innovative Materials Technology (2015), Flextronics (2015), Magneto Dynamics (2015), Depuy Otho Johnson and Johnson (2015), American Orthodontics (2015), CerCo (2015), Materials Processing (2015-2016), EZPEDO (2015-2016), Tungsten Heavy Powder and Parts (2016), Amphenol (2016), IRIS Exhibition (2016-2017), General Electric (2016), 3DEO (2016-on), Hewlett Packard (2017), McAndrews Held and Mallory (2017).

Participation in Company Formation

Newmet Tubular Products, Inc. (part owner, board of directors); subsequently divided with part sold to DuPont and balance consolidated into Newmet Products and sold to GKN Sinter Metals
Xform, Inc. (co-founder, part owner, patentee, board of directors)
Thermat, Inc. (co-owner, co-founder, board of directors); subsequently formed into Thermat Precision, then MedSource, acquired by Accellent
Innovative Material Solutions, Inc. (co-founder, part owner, board of directors)
Klinair Environmental Technology, Ltd. (part owner, board of directors)
InfoCent, Inc. (president)
Aesthetic Materials, Inc. (co-founder, co-owner, patentee, board of directors)
PowderTech, Inc. (board of directors)
T & R Technology, Inc. (co-founder, co-owner, board of directors)
Allomet (patentee, board of directors)
AMTellect (founder, president, board of directors), now part of Advanced Materials Technology
International Nontoxic Composites (part owner, board of directors); includes subsidiary operations of INTC USA, Delta Frangible, Raker, and Springfield Munitions; now part of Freedom Group (Cerberus Investment)
Young Technologies LLC (advisor).

Sponsored Research, Contracts and Grants

equipment donations

GE Research and Development, Bell Laboratories, Lawrence Livermore National Laboratory, Airco, Paul O. Abbe, Teledyne Industries, Denpac, Forster-Wheeler, IBM, Patterson Kelley, ATM, Readco, Comalco, TA Instruments, Engle, Star Automation, Kistler, Malvern, Horiba Instruments, CM Furnaces, Digital Equipment, Toyo Kohan, NASA, Readco, Arburg, BASF, Air Products and Chemicals, Cabot, Coulter Electronics, API-TSI, Micromeretics, DTM, Wabash MPI, KYK Corp, Battenfeld, Gassbare, Loedgie.

unrestricted grants

Allied-Signal Corp., Newmet Products, Eastern New York ASM Chapter, Center for Powder Metallurgy Technology (several), Sumitomo Metal Mining (three times), Alcoa, Sherwood Refractories, BASF (twice), J. M. Ney, Thermat (several), Innovative Material Solutions (several), Smith International (several), Argonide, Boston Scientific, Klinair Environmental Technologies, Dow Chemical, Megamet Industries, Injectamax, Symmco (annual), Kent Gamebore, Respironics, Slumberge, Advanced Forming Technology, Advanced Materials Technologies, Tin-Tungsten Technologies, International Nontoxic Composites, Korea-US Science and Engineering Cooperative Center.

student scholarships and fellowships

Sandvik (4 years), Rensselaer Polytechnic Institute, Allegheny Ludlum Steel, International Nickel Company, Hoeganaes (4 years), IBM (4 years), Defense Advanced Research Projects Agency (twice, 2 years each), GE Foundation, W. R. Grace, Kulite Tungsten, British Oxygen Corporation (2 years), Penn State Dean's Fellowship (3 years), BASF (3 years), J. M. Ney, U. S. Army, Harvey Brush Fellowship, Arlan Clayton Family Scholarship (three times), AMETEK Foundation Scholarship (three times), College of Engineering Travel Grants (four times).

funded proposals (approximately $59 million cumulative)

"Acquisition of a Precision High Temperature Dilatometer," National Science Foundation (grant 8015579), 18 month (1981), $36,000.

"Quantitative Characterization of the Chemical Stability of Gold Dental Alloys," International Gold Corp., 36 month (1981), $40,000.

"Potentiodynamic Laboratory Corrosion System," Public Health Service (1981), $15,000.

"A Training Grant in Dental Materials," National Institute for Dental Research, 120 month (1981, renewed 1986), L. Katz and five other faculty, $1,500,000.

"Reduced Grain Boundary Mobility and the Sintering of Molybdenum," U. S. Army Research Office, 30 month (1981), $105,000.

"Structural Refractory Metals Processed by Activated Sintering," Engineering Foundation, 12 month (1981), $20,000.

"High Density Ferrous Components by Activated Sintering," Remington Arms Co., 24 month (1981), $48,000.

"Toughness Improvements in Tungsten Heavy Alloys," Lawrence Livermore National Laboratory, 29 month (1981), $37,000.

"Experimental Tests to Unify Sintering Theory," Department of Energy, 24 month (1982) with R. Doremus, $400,000.

"Development of Transient Liquid Phase Sintering," Supermet Division of Stanadyne Corp., 24 month (1982), $96,000.

"Chemical Stability of Low Nobility Dental Alloys," National Institute for Dental Research, 36 month (1982), $124,000.

"Acquisition of a Particle Size Analyzer," National Science Foundation (grant 8209821), 18 month (1982), $36,000.

"Powder Metallurgy Fabrication of Diode Heat Sinks," General Instrument Corp., 36 month (1982), $105,000.

"The Properties of Refractory Metals Processed by Enhanced Sintering Treatments," U. S. Army Research Office, 36 month (1984), $103,000.

"Property Optimization in Ferrous Powder Metallurgy," Gleason Memorial Fund, 24 month (1984), $99,000.

"Microstructure - Impurity Interactions in Tungsten Heavy Alloys," Teledyne Firth Sterling, 36 month (1984), $75,000.

"Tests and Modeling for Sintering Theory," Department of Energy, 24 month (1984), with R. Doremus, $400,000.

"Acquisition of a Color Spectrophotometer," National Institutes of Health, 12 month (1984), $12,500.

"Correlation of Biological and Laboratory Tests of Gold Alloys," International Gold Corp., 12 month (1984), $48,000.

"Powder Metallurgy Fabrication of Heavy Alloy Systems," California Research and Technology, 24 month (1985), $200,000.

"Acquisition of a High Temperature Vacuum Sintering Furnace," National Science Foundation (grant 8420182), 12 month (1985), $110,000.

"High Temperature Composites Based on Titanium Carbide," New York State Science and Technology Foundation and Alloy Technology International, 12 month (1986), $40,000.
"Preliminary Investigations on High Hardness Heavy Alloys," Ballistic Research Laboratory, Aberdeen Proving Grounds, 6 month (1986), $35,000.
"Gravity Effects on Liquid Phase Sintering," National Aeronautics and Space Administration, 24 month (1986), $200,000.
"Design, Analysis, and Fabrication of Innovative High Temperature Structural Composites," Defense Advanced Research Projects Agency, 60 month (1986), with J. Diefendorf, S. Strenstein, R. Doremus, J. Hudson, D. Duquette, N. Stoloff, E. Krempl, C. Sims, L. Interrante, G. Dvorak, $12,500,000.
"Injection Molded Tungsten Alloys and Compounds," Metadyne and New York State Science and Technology Foundation, 12 month (1986), $12,500.
"Advanced Powder Processing," RPI Center for Manufacturing Productivity and Technology Transfer (a multiple company program, peaked at 30 sponsors), 72 month (1986), with R. Messler, C. Chung, D. Lee, $2,950,000.
"Microstructure and Impurity Effects on Tungsten Heavy Alloys," U. S. Army Research Office, 36 month (1987), $150,000.
"Texture Effects and High T_c Superconducting Wire," National Science Foundation (grant 8718215), 6 month (1987), with R. Wright, R. Doremus, K. Raman, D. Knorr, $50,000.
"Processing of High T_c Superconducting Wire," New York State Energy Research and Development Authority, 12 month (1988) with K. Raman, R. Wright, $60,000.
"Reactive Sintering of Aluminides," Alcoa Foundation, 12 month (1988), $20,000.
"Feedback Controlled Sintering," New York State Center for Advanced Technology in Automation and Robotics, 12 month (1988), $48,000.
"High Temperature Silicon Carbide Heat Exchanger for Filament Wound Composite Construction," Advanced Automation and New York State Science and Technology Foundation, 12 month (1988), $12,000.
"Gravitational Effects on Liquid Phase Sintering," National Aeronautics and Space Administration, total duration 120 month in 12 month increments (started 1988), $1,530,000 total.
"Gas Analysis Equipment for Closed-Loop Feedback Controlled Sintering," New York State Center for Advanced Technology in Automation and Robotics, equipment (1989), $48,000.
"High Temperature Thermal Processing," New York State Energy Development Authority, 36 month (1990), with R. Wright, $1,000,000.
"High Performance Heavy Alloys by Alloying and Process Control," U. S. Army Research Office, 36 month (1990), $155,000.
"Process Development for Coated Fine Powders," New York State Center for Advanced Technology in Automation and Robotics, 12 month (1990), with M. Morgan, $75,000.
"Metal/Ceramic Injection Molding," Teledyne, 4 month (1990), $40,000.
"Assessment of Powder Injection Molding for Manufacture of Heat Sink Materials," Digital Equipment Corp., 10 month (1990), $40,000.
"Optimization of Mixing for Powder Injection Molding," Teledyne Readco and Ben Franklin Technology Center, 36 month (1991), $75,000.
"PIM Materials for Thermal Management," Digital Equipment Corp., 21 month (1991), $40,000.
"The Effects of Binder and Powder Characteristics on Microstructure Evolution in Liquid Phase Sintering," GE Aircraft Engines, 18 month (1992), $150,000.
"Engineering and Process Design Expertise in Support of Optimization of Powder Injection Molding," Metalworking Technology Inc., 12 month (1992), $20,000.
"Tungsten/Copper Microelectronic Package Prototype Process and Geometry Development,"

Witec Corp., 12 month (1992), $40,000.
"Rapidly Solidified Copper-Base Solder Powders," Toranaga Technologies, 24 month (1992), $12,500.
"Lightweight Thermal Management Materials," Teledyne Monolithic Microwave, 6 month (1992), $20,000.
"High Thermal Conductivity Molybdenum-Copper by Powder Metallurgy Techniques," Climax Specialty Metals, 15 month (1992), $12,000.
"Corrosion Resistant, Magnetic Powder Metallurgy Ferrous Alloys," Alpha Sintered Metals and Ben Franklin Technology Center, 12 month (1992), with B. Shaw, $37,500.
"Powder Injection Molding of Navy Weapon Systems Components," Concurrent Technologies Corp., 24 month (1993), with K. Hens, $22,000.
"Tailored Tungsten Heavy Alloy Microstructures for High Strain Rate Behavior," U. S. Army Research Office, 36 month (1993), $280,000.
"The Sintering of High Surface Area Tantalum Powders," Cabot Performance Materials, 48 month (1993), $250,000.
"Characterization of Partitioned Alloy Component Healing Wide Gap Braze Systems," GE Aircraft Engines, 27 month (1993), with R. Iacocca, $185,000.
"Powder Injection Molding of Nanoscale Tungsten Carbide," Nanodyne Inc., 24 month (1993), $63,000.
"Novel Structural Materials Through Microstructural Control in Liquid Phase Sintering," National Science Foundation (grant 93012271), 36 month (1993), $225,000.
"Meeting on Small Particle Sintering," National Science Foundation (grant 9321167), 6 month (1993), $20,000.
"Advanced Processing via Powder Injection Molding," industrial consortium (peaked at 17 companies), 48 month (1993), with K. Hens, R. Iacocca, R. Raman, S. Atre
"Aqueous Injection Molding of Silicon Nitride Ceramic Components Using the Allied-Signal Agar System," Allied-Signal Aerospace Corp., 36 month (1994), with K. Hens, $300,000 (with $300,000 matching).
"Direct Injection Molding of Superstrength Metal Matrix Composites," National Science Foundation (grant 9406800), 12 month (1994), with K. Hens, $50,000.
"Metastable Gas Atomized Solder Materials," Toranaga Technologies Corp., 18 month (1994), $67,000, with R. G. Iacocca.
"Dimensional Control in Powder Injection Molding," BASF, 18 month (1994), $50,000.
"Acquisition of a Vacuum Sintering Furnace System," National Science Foundation (grant 9402508), 12 month (1994), $108,000.
"X-Ray Collimator Grids by Powder Metallurgy Techniques," Jet Propulsion Laboratory, 6 month (1994), with J. Johnson, $5,000.
"Powder Injection Molding of Aluminum Oxide and Silicon Nitride," Caterpillar Corp., 12 month (1994), with K. F. Hens, $185,000
"Ultrasonic Sensors and Controls for Powder Injection Molding," National Science Foundation (grant 9408878), 36 month (1994), with J. Rose, A. Griffo, and K. Hens, $300,000.
"Dimensional Control in Iron-Copper-Carbon Powder Metallurgy," Airco Industrial Gases and Daewoo Heavy Industries, 12 month (1994), $40,000.
"A Global Study of Superalloy Powder Metallurgy," General Electric Aircraft Engines, 36 month (1995), with R. Iacocca, $300,000.
"Low Cost Powder Metal Injection Molding," Allied-Signal Corp, Corporate Technology, 36 month (1995), with S. Atre, $300,000.
"Novel Processing Opportunities for High Strain Rate Tungsten-Based Composites," U. S. Army Research Office, 36 month (1995), $330,000.
"Industrial Collaboration in Powder Metallurgy," Various Industrial Partners (Eleven Total) and

Ben Franklin Technology Center, 36 month (1995), $150,000 direct and $150,000 matching, for $300,000 total per year or $900,000.

"Acquisition of Microscopic Materials Characterization System for the Development of Novel Tungsten-Based Composites," Office of Naval Research, 12 month (1995), with R. Iacocca, $120,000.

"Consortium for Powder Metallurgy," Ben Franklin Technology Center and 14 companies, 12 month (1995), $150,000.

"Acquisition of a Three-Dimensional Microscopic Image Analysis System," National Science Foundation (grant 9500119), 12 month (1995), with R. Iacocca, $80,000.

"Ceramic Technology for Broad Based Manufacturing," Department of Commerce, 12 month (1995) with Clifford Ballard (Allied-Signal Corp.), $100,000.

"Processing Research on Dispersion Strengthened Tungsten-Cobalt Alloys," Army Research Office, 36 month (1995), $330,000.

"Cobalt Chrome Injection Molding of Medical Implants," Innovative Material Solutions and Zimmer Corp., 6 month (1995), with R. Iacocca and T. Weaver, $60,000.

"Fundamental Insight into the Performance of Solder Powders and Pastes," Alpha Metals, 24 month (1996), with R. Iacocca, $80,000.

"Pressureless Forming Techniques for Aircraft Engine Repair," GE Aircraft Engines, 18 month (1996), with R. Iacocca, $150,000.

"Powder Injection Molding of M2 Tool Steel," BASF, 18 month (1996), $50,000.

"Acquisition of Elemental Analysis Equipment for Engineering Materials," National Science Foundation (grant 9622213), 12 month (1998), with R. Iacocca, $200,000.

"The Agglomeration of Tantalum Powder," Cabot Performance Materials, 8 month (1997), with S. Atre, $24,000.

"PM Consortium," AGA Gases, Alpha Sintered Metals, Quebec Metal Powders, United States Bronze Powders, Ben Franklin Technology Center, Innovative Material Solutions, and MATSYS, 36 month (1997), with T. Weaver, R. Iacocca, and A. Griffo, $150,000.

"Component Shape Retention in Liquid Phase Sintering of Prealloyed Powders," National Science Foundation (grant 9610280), 36 month (1997), $297,000.

"Double Cemented Tungsten Carbides," Smith International, 12 month (1997), $20,000.

"Sendust Powder Modification," Brush Industries, 12 month (1997), with M-J. Yang, $14,500.

"Protocol Development for Measuring Particle Size of Agglomerated Tungsten Carbide Powders," Dow Chemical, 12 month (1997), with R. Iacocca, $12,000.

"Pressureless Forming Techniques for Aircraft Engine Repair," 12 month (1997), with R. Iacocca, $80,000.

"Characterization of Porous Filtration Media," Klinair Environmental Technologies, 12 month (1997), with R. Iacocca and B. Shaw, $105,000.

"Projectile Production by Powder Metallurgy Routes," Remington Arms, 12 month (1997), with S. Atre, $40,000.

"Presuresless Bonding of Tungsten Carbide for Wear Resistant Applications," Westinghouse Electric, 12 month (1997), with R. Iacocca, $68,691.

"Stainless Steel Powder Metallurgy," Boston Scientific, 12 month (1997), with T. Weaver, $25,000

"Rational Atmosphere Selection for Sintering Stainless Steels," Air Products and Chemicals, 24 month (1997), $59,919.

"Development of Cermet and Ceramic Materials for Service in Diesel Engines," Cummins Engine, 18 month (1997), $110,000.

"Development of Tungsten Microcomposites," Johns Hopkins University, 18 month (1997), $45,000.

"Gravitational Effects on Distortion in Sintering," National Aeronautics and Space Administration,

96 month (1998 to 2006), $2,000,000.
"Lubricant Development for Die Compaction," GKN Sinter Metals, Lonza, CM Furnaces, Kawasaki, and Ben Franklin Technology Center, 18 month (1998), with S. Atre, A. Griffo, and R. Iacocca, $60,000.
"Powder-Binder Agglomeration," Delaware Corp., 12 month (1997), with S. Atre, $125,000.
"Non-Eroding Tungsten Nozzles Formed via Metal Injection Molding," Thiokol, 12 month (1997), with A. Griffo and J. Thomas, $57,000.
"Rapid Metal Prototyping and Tooling via Piezoelectric Jetting," Sanders Prototype, 18 month (1997), with T. Weaver, $116,000.
"Full Density Sintering of Water Atomized Iron and Steel Powders in a Conventional Sintering Cycle and Furnace," Hoeganaes, 18 month (1998), $100,000.
"Dimensional Precision in Sintered Cemented Carbides," Kennametal, 18 month (1998-1999), $85,000.
"Advanced Studies in Solder Powders and Pastes," Alpha Metals, 12 month (1998), with R. Iacocca, $135,000.
"Powder Injection Molding of Nickel-Titanium Shape Memory Alloy," Boston Scientific, 12 month (1998), with R. Iacocca, $25,000.
"Injection Molding of Porous Ceramic Materials," Porvair Advanced Materials, 12 month (1998), with S. Atre, $10,000.
"Titanium Powder Metallurgy Using Novel Titanium Powders," Idaho Titanium, 12 month (1998-1999), $103,000.
"Process Specification for Powder Metallurgy Component Fabrication to Targeted Features and Quality; An Inverse Problem," National Science Foundation (grant 9813207), 36 month (1998), with J. L. Rose and R. Engel, $300,000.
"Powder Flowability and Milling," Slumberger, 12 month (1998), with R. Iacocca, $25,000.
"Development of Double Cemented Tungsten Carbides for Rock Drilling Applications," Smith International, 48 month (1998), $40,000.
"Advanced Processing and Characterization of Tantalum-Based Alloys by Powder Metallurgy," Prairie View A&M University, 12 month (1998), with M-J. Yang, $22,000.
"Acquisition of Advanced Rheological System," National Science Foundation, 12 month (1998), with R. G. Iacocca, $172,000.
"Direct Injection Molding of Tungsten Liners," Slumberger Well Services, 12 month (1998), with R. Iacocca, $43,000.
"Modeling Thermal Cracking of Conventional Cemented Carbides," Smith International, 36 month (1999), $6000.
"P/M Parts Via Low Pressure Pressing and Sintering," Southco Corp., 6 month (1999), $5,000.
"Brazing and Joining of High Performance P/M Components," Southco Corp., 6 month (1999), $5,000.
"Physical Property Testing," Arnold Engineering, 6 month (1999), with M. J. Yang, $5,000.
"Sintering Processing," Deloro Stellite Corp., 12 month (1999), $22,000.
"Development of an Aluminum Alloy for Selective Laser Sintering," DTM Corp., 12 month (1999), with R. Iacocca and N. Myers, $80,000.
"Rapid Tooling via Powder Metallurgy Routes," Technical Assistance and Development, 15 month (1999), with S. Atre, $125,000.
"Acquisition of Thermal Analysis Equipment for Engineering Materials," National Science Foundation (grant 9900172), 12 month (1999), with R. Iacocca, $80,537 total award $160,000.
"Evaluation of a Ti-6Al-4V Powder for Injection Molding," Universal Technology Corp., 12 month (1999), with T. Weaver, $45,000.
"Submicron Cemented Carbides," Iscar Corp., 6 month (1999), with M. J. Yang, $4,000.

"Development of an Iron Powder Injection Molding Process from Water Atomized Powder," Hoeganaes Corp., 12 month (1999), $74,000.
"Development of High Temperature Solder Materials," General Electric Lighting, 9 month (2000), with R. Iacocca, $65,867.
"Center for Innovative Sintered Products," consortium program, supported by 95 companies and the Pennsylvania Technology Investment Authority of the Commonwealth of Pennsylvania, 12 month (2000), with P. Cohen, R. Iacocca, R. Engel, and I. Petrick, $1,635,000.
"Production of Highly Loaded Suspensions," Alpha Metals, 9 month (1999-2000), with R. G. Iacocca, $106,990.
"Porous Tip Fabrication," Applied Research Laboratory, 3 month (2000), with D. Heaney, $10,000.
"Sintered Brazing Rings," Caterpillar Inc., 3 month (2000), with N. Myers, $4,000.
"Acquisition of Solid Freefrom Fabrication Laboratory for Interdisciplinary Research and Education in Manufacturing through a University/Industry Consortium," National Science Foundation (grant 0079397), 36 month (2000), with J. DuPont, $106,000.
"Development of an Aluminum Alloy for Selective Laser Sintering," DTM Corp., 12 month (2000), with N. Myers, $80,000.
"Development of an Iron Powder Injection Molding Process from Water Atomized Powder," Hoeganaes Corp., 12 month (2000), $74,000.
"Investigation of Feasibility of Using Supplied Sample to Manufacture Pressed and Sintered Components," Deloro Stellite, 3 month (2000), with K. Cowan, $3,500.
"Development of a Molding Process for Whiteware," Pfaltzgraff Corp., 12 month (2000), with S. Atre, $40,000.
"Novel Coating Method for Hard, Corrosion Resistant and Thermally Stable Surfaces," Moog Inc., 18 month (2000), with R. Iacocca, $203,155.
"Evaluation of Nano Grain Size WC Powder," Deloro-Stellite Inc., 3 month (2000), with N. Myers, $8,000.
"An Innovative Knowledge System for Rapid Expansion of Net Shape Manufacturing Industry via Powder Metal Injection Molding," Honeywell Inc., 12 month (original funding was for 36 month) (2000), $100,000.
"The Study of Microstructure and Properties of Nanosized TiAl and Cemented Carbides Made by Pressureless, Sinter-HIP, and Powder Compaction," Ceracon Inc., 9 month (2000), $45,000.
"Applications of Neural Networks to Solder Material Development," Fry Technologies, 18 month, with R. Iacocca, $163,530.
"Preparation of Tungsten Carbide Tooth Cap and Testing Specimen by Powder Injection Molding," Smith International, 2 month (2000), with H. Zhang, $7,875.
"Method for Sintering Metal Flakes and Porous Metal Structures Created Thereby," Transmet Corp., 12 month (2000), with N. Myers, $25,000.
"Development of High Temperature Solder Materials," General Electric Lighting, 12 month, with R. Iacocca, $125,000.
"The Bonding of Hard and Soft Co-Injection Molded Metal Powder Parts," Advanced Materials Technologies, 6 month (2001), with D. Heaney, $20,000.
"Analysis of Separator Sheets for Sintering of Stainless Steels," Pall Corp., 12 month (2001), with D. Heaney, $60,053.
"Center for Innovative Sintered Products," consortium program, supported by subscription ranging from 65 to 106 companies and the Pennsylvania Technology Investment Authority of the Commonwealth of Pennsylvania, 60 month (2001 to 2006), with P. Cohen, S. Beyerle, R. Engel, and I. Petrick, $4.4 million.

"Sintering Optimization Design of Experiments for Injection Molded Stainless Steels," Southco Corp., 12 month (2001), with D. Heaney, $60,000.
"Powder Injection Molding of Tungsten Heavy Alloy Fragmentation Devices," Applied Research Laboratory, 60 month (2001-2006), with D. Heaney, $230,000.
"Glass to Metal Hermetic Sealing for Electronic Packaging Applications," Advanced Materials Technologies, 6 month (2001), $39,600.
"Technical and Economic Evaluation of Two Potential Metal Powder Injection Molded Components - Reamer and Die Chaser," Ridge Tool, 6 month (2001), $4,000.
"Forming Technologies Using Tin-Tungsten Based Composites," International Tin Tungsten Technologies Inc., 6 month (2001), with S. Atre, $100,000.
"Iron Powders in Food Fortification," SUSTAIN, 2 month (2001), with L. Campbell, $4,000.
"PIM of X-Ray Shielding Device Components," Golden Engineering Inc., 3 month (2001), with S. Atre, $12,000.
"Manufacturing Tooth Cap from DC Carbide by Injection Molding," Smith International, 12 month (2001), $50,000.
"Fabrication and Testing of Novel Extrusion Dies," Corning Inc., 6 month (2001), $37,206.
"Evaluation of Hard Coatings," Deloro Stellite Inc., 2 month (2001), with N. Myers, $3,500.
"Evaluation of Crucible Tool Steel Powders for MIM," Crucible Research, 6 month (2001), with D. Heaney, $14,000.
"Protocol Development for Net Shape Powder Metal part Production via Cold Compaction," National Science Foundation (grant 0200554), 36 month, with J. Rose, R. Engel, and S. Atre, $566,000.
"Novel Coating Method for Hard, Corrosion Resistant and Thermally Stable Surfaces," Moog Inc., 24 month (2002), with N. Myers, $200,000.
"An Innovative Knowledge System for Rapid Expansion of Net Shape Manufacturing Industry via Powder Metal Injection Molding; Sintering Modeling Studies," Polymer Technology Inc., 36 month (renewal of Honeywell project) (2002-2005), $400,000.
"Fabrication and Testing of Novel Extrusion Dies, Part 2," Corning Inc., 6 month (2003), with P. Suri, $42,000.
"Center for Innovative Sintered Products," Pennsylvania Technology Investment Authority, 105 companies, and Pennsylvania State University, 48 month (2000), approximately $1,500,000 per year; total $6,000,000.
"Use of Low Cost Powders for Injection Molding," Hoeganaes Corp., 12 month (2002), with N. Myers, $40,000.
"Cost Center, Laboratory Development," various sponsors, 12 month (2003), with D. Heaney and L. Campbell, $60,000.
"Multiple Axis In Situ Monitoring of Debinding and Sintering," Center for Innovative Sintered Products, 24 month (2002-2004), with C. Binet, $125,000.
"Fundamentals Limitations and Capabilities of High-Density P/M," Center for Innovative Sintered Products, 18 month (2003-2004), with N. Myers, $90,000.
"Press and Sinter Processing Realities with Nanoscale Powders (nano-P/M)," Center for Innovative Sintered Products, 12 month, 2004, $60,000.
"Hole Plate Scale Up Demonstration and Feasibility of Primary Elements," Corning Inc., 6 month, 2004, $40,000.
"Processing of Tungsten Heavy Alloys Exhibiting Adiabatic Shear," Kennametal Technology Center and Army Research Laboratory, 12 month, 2005, $63,000.
"Mapping the Densification and Grain Growth of Nanoscale Tungsten Carbide," Kennametal Breakthrough Technology, 12 month, 2005, $107,000.
"Press and Sinter Processing Realities with Nanoscale Powders (nano-P/M)," Center for Innovative Sintered Products, 12 month, 2005, $30,000.

"Technical and Economical Comparison of Micro Powder Injection Molding and Detailed Linkages from Powder Characteristics to Press-Sinter Processing of Metallic Parts," Center for Innovative Sintered Products, 12 month, 2005, with S. J. Park, $20,000.

"Microstructural Evolution in Liquid Phase Sintering," Center for Innovative Sintered Products, 12 month, 2005, $15,000.

"Center for Advanced Vehicular Systems," Mississippi Institutes of Higher Learning, 12 month, 2005, $3,600,000.

"Tungsten-Polymer Formulations," ATI Alldyne, 8 month, 2005, $62,500.

"International Research Experience for Students in Innovative Sintered Materials (Spain)," National Science Foundation (grants 0525887 and 0603608), 2005-2008, 36 month, with S. Elder, $104,904.

"Center for Advanced Vehicular Systems," State of Mississippi Economic Development Authority, 12 month, 2006, $3,720,000.

"A Fundamental and Applied Investigation of Magnesium Alloy and High Strength Materials for Automotive Use," Department of Energy, Freedom Car Crash Center, 2006, 24 month, with S. G. Kim, H. Rhee, M. Horstemeyer, and G. Olsen, $100,256.

"Examining Fundamental Mechanism of Tooling Wear (for Powder Processing)," Department of Energy, Freedom Car Crash Center, 2006, 24 month, with S. J. Park, P. Wang, Y. Hammi, and H. El Kadiri, $587,469.

"Advanced Power Distribution Prototyping, Evaluation, and Simulation," U. S. Army Space and Missile Defense Command, 2006, 12 month, $1,200,000.

"Center for Virtual Design and Manufacturing," Oak Ridge National Laboratory, 2006, 24 month, with M. Horsetmeyer, P. Wang, S. Daniewicz, J. Berry, P. Felicelli, T. Lacy, P. Gullett, S. G. Kim, C. Campbell, H. Lim, S. Elder, T. Haupt, S. J. Park, Y. Hammi, G. Potirniche, H. El Kadiri, $4,000,000.

"Tungsten-Polymer Formulations," ATI Alldyne, 2006, 9 month, $68,507.

"Advanced Power Distribution Prototyping, Evaluation, and Simulation," U. S. Army Space and Missile Defense Command, DASG60-00-C-0074, 2006, 4 month, $400,000.

"Center for Advanced Vehicular Systems," State of Mississippi Economic Development Authority, 12 month, 2007, $3,900,000.

"Bio-Inspired Design - Enabling Technologies in the Life and Material Sciences," Office of the President, Mississippi State University, 2007, with G. Thibaudeau and S. Willard, $48,314.

"Symposium of Predictive Science and Technology in Mechanics and Materials," Office of the President, Mississippi State University, 2007, with P. Wang and M. Horstemeyer, $50,000.

"Southern Regional Center for Lightweight Design," Department of Energy, 12 months, with S. G. Kim, E. Marin, T. Haupt, Y. A. Xue, M. Rais-Rohani, S. J. Park, P. Wang, and H. Horstemeyer, total funding with cost-matching contributions $3,180,000, 2007.

"Center for Advanced Vehicular Systems," State of Mississippi Economic Development Authority, 12 months, 2008, $3,805,042.

"Advanced Power Distribution Prototyping. Evaluation and Simulation," U. S. Army Space and Missile Defense Command, 30 months, 2009, $2,154,154, with M. Mollen.

"A Workshop for Scientific Issues on Medical Applications of Micro/Nano Powder Injection Molding – Molding, Sintering, Modeling, and Commercial Applications," co-funded by National Science Foundation and Korea-US Science Cooperation Organization, 12 months, 2008, $42,300.

"Development of High Performance Nano-sized Tungsten Heavy Alloy Composites by Powder Metallurgy," co-funded by National Science Foundation and USAID Egypt, 36 months, 2009, $100,000, with Sayed Moustafa.

"Advanced Armor and Anti-Armor Components by Spark Plasma Sintering," Defense Advanced Research Projects Agency, 9 months, 2009, $300,000, with E. Olevsky.

"Multi-Scale Modeling and Experimentation on Liquid Phase Sintering in Gravity and Microgravity Environments," National Aeronautics and Space Administration, Marshall Space Flight Center, 36 months, 2010, $450,000, with E. Olevsky.

"Multi-Scale Modeling and Experimentation on Liquid Phase Sintering in Gravity and Microgravity Environments: Flight Experiments in Liquid Phase Sintering in Gravity and Microgravity Environments," National Aeronautics and Space Administration, Marshall Space Flight Center, 24 months, 2013, $300,000, with E. Olevsky.

"Multi-Scale Modeling and Experimentation on Liquid Phase Sintering in Gravity and Microgravity Environments," National Aeronautics and Space Administration, Marshall Space Flight Center, 30 months, grant NNX16AK21G, 2016, $375,000, with E. A. Olevsky.

Publication List

Authored Books (translations into Arabic, Chinese, Japanese, Korean, Russian, and Turkish)

1. R. M. German, *Powder Metallurgy Science,* Metal Powder Industries Federation, Princeton, NJ, 1984, 279 pages; translated and published in Arabic.
2. R. M. German, *Solution Guide to Study Questions,* Metal Powder Industries Federation, Princeton, NJ, 1984, 56 pages, revised 1994.
3. R. M. German, *Liquid Phase Sintering,* published in English by Plenum Press, New York, NY, 1985, 251 pages; translated and published in Japanese by Uchida Rokakuho Publishing Co., Tokyo, Japan, 1992.
4. R. M. German, *Particle Packing Characteristics,* Metal Powder Industries Federation, Princeton, NJ, 1989, 458 pages.
5. R. M. German, *Powder Injection Molding,* Metal Powder Industries Federation, Princeton, NJ, 1990, 522 pages; translated and published in Chinese.
6. R. M. German, *Powder Metallurgy Science*, second edition, Metal Powder Industries Federation, Princeton, NJ, 1994, 472 pages; translated and published in Japanese, Russian, and Arabic.
7. R. M. German, *Sintering Theory and Practice,* Wiley-Interscience, New York, NY, 1996, 558 pages; translated and published in Korean and Turkish.
8. R. M. German and R. G. Cornwall, *The Powder Injection Molding Industry - an Industry and Market Report*, Innovative Material Solutions, State College, PA, 1997, 669 pages.
9. R. M. German and A. Bose, *Injection Molding of Metals and Ceramics*, Metal Powder Industries Federation, Princeton, NJ, 1997, 413 pages; translated and published in Chinese.
10. R. M. German, *Powder Metallurgy of Iron and Steel*, John Wiley and Sons, New York, NY, 1998, 496 pages.
11. R. M. German and R. G. Cornwall, *Powder Injection Molding in the Year 2000 an Industry and Market Report*, Innovative Material Solutions, State College, PA, 2000, 321 pages plus companion compact disk database.
12. Randall M. German, *User's Guide to Powder Injection Molding -Designs and Applications*, Innovative Material Solutions, State College, PA, 2003, 320 pages; translated and published in Chinese with Juipeng Song, China Machine Press, Shanghai, China, 2011.
13. Randall M. German, *Powder Metallurgy and Particulate Processing*, Metal Powder Industries Federation, Princeton, NJ, 2005, 515 pages; translated and published in Turkish as *Toz Metalurjisi ve Parcacikli Malzeme Islemleri*, S. Saritas, M. Turker and N. Durlu (eds.), TTMO, Ankara, Turkey, 2007; translated and published in Chinese; translated and published in Korean by the Korean Powder Metallurgy Institute 2012.
14. Randall M. German, *A-Z of Powder Metallurgy*, Elsevier Scientific, Oxford, UK, 2005, 276 pages; computer software version published 2009.
15. Randall M. German and Seong Jin Park, *Mathematical Relations in Particulate Materials Processing*, John Wiley and Sons, Hoboken, NJ, 2008, 452 pages;

computer software version published 2009.

16. Randall M. German, *Metal Injection Molding: A Comprehensive MIM Design Guide*, Metal Powder Industries Federation, Princeton, NJ, 2011, 196 pages.
17. Randall M. German, *PM Condensed*, Metal Powder Industries Federation, Princeton, NJ, 2012.
18. Randall M. German and Sundar V. Atre, *Powder Injection Molding Market Report*, PIM 2013 Market Study, Scipivision, New York, NY, 2013, 168 pages.
19. Randall M. German, *Sintering: From Empirical Observations to Scientific Principles*, Elsevier Scientific, Waltham, MA, 2014, 531 pages.
20. Randall M. German, *Particulate Composites; Fundamentals and Applications*, Springer, New York, NY, 2016, 436 pages.

Edited Books

1. R. M. German and K. W. Lay, editors, *Processing of Metal and Ceramic Powders*, The Metallurgical Society, Warrendale, PA, 1982, 337 pages.
2. P. H. Booker, J. Gaspervich, and R. M. German, editors, *Powder Injection Molding Symposium - 1992*, Metal Powder Industries Federation, Princeton, NJ, 1992, 511 pages.

3-11. J. Capus and R. M. German, editors, *Advances in Powder Metallurgy and Particulate Materials,* nine volumes, Metal Powder Industries Federation, Princeton, NJ, 1992.

12-15. A. Bose, R. M. German, and A. Lawley, editors, *Reviews in Particulate Materials*, vol. 1 (1993), vol. 2 (1994), vol. 3 (1995), vol. 4 (1996), Metal Powder Industries Federation, Princeton, NJ.

16. R. M. German, G. L. Messing, and R. G. Cornwall, editors, *Sintering Technology*, Marcel Dekker, New York, NY, 1996, 524 pages.
17. R. M. German, H. Wiesner, and R. G. Cornwall, editors, *Powder Injection Molding Technology*,, Innovative Material Solution, State College, PA, 1998, 428 pages.
18. P. W. Lee, Y. Trudel, R. Iacocca, R. M. German, B. L. Ferguson, W. B. Eisen, K. Moyer, D. Madan, and H. Sanderow, editors, *Powder Metallurgy Technologies and Applications*, vol. 7 ASM Handbook, ASM International, Materials Park, OH, 1998, 1128 pages.
19. R. M. German, G. L. Messing, and R. G. Cornwall, editors, *Sintering Science and Technology*, Pennsylvania State University, University Park, PA, 2000, 439 pages.

Patents

1. "Noble Metal Alloy for Dentistry and Dental Restoration Using Same," R. M. German, U.S. Patent 4,205,982, issued June 1980.
2. "Dimensionally Stable Powder Metal Compositions," R. M. German, C. Lall, and D. S. Madan, U.S. Patent 4,612,048, issued September 1986, Canadian patent issued 30 October 1990.
3. "Production of Reactive Sintered Nickel Aluminide Material," R. M. German, A. Bose, and D. Sims, U.S. Patent 4,762,558, issued August 1988.

4. "High Strength, High Hardness Tungsten Heavy Alloys with Molybdenum Additions and Method," R. M. German, A. Bose, and D. Sims, U.S. Patent 4,801,330, issued 31 January 1989.
5. "Hardness and Strength of Heavy Alloys by the Addition of Tantalum," A. Bose and R. M. German, U.S. Patent 4,851,042, issued 25 July 1989.
6. "Palladium Based Powder Metal Alloys and Method for Making Same," R. M. German, L. L. Bourguignon, D. P. Agarwal, and S. Farooq, U. S. Patent 5,000,779, issued 19 March 1991.
7. "Two Stage Fast Debinding of Injection Molding Powder Compacts," T. S. Wei and R. M. German, U. S. Patent 5,028,367, issued 2 July 1991.
8. "Process for Reducing Oxides Contained in Iron Powder Without Substantial Decarburization Thereof," E. Streicher and R. M. German, U. S. Patent 5,234,489, issued 10 August 1993.
9. "Process for Making Finely Divided Intermetallic," K. G. Shaw, D. E. Alman, R. M. Cooper, R. M. German, and K. P. Mc Coy, U. S. Patent 5,330,701, issued 19 July 1994.
10. "Process for Controlling Carbon Content of Injection Molding Steels During Debinding," E. Streicher and R. M. German, U. S. Patent 5,334,341, issued 2 August 1994.
11. "Particulate Feedstock for Metal Injection Molding," A. R. Kjar, R. G. Iacocca, R. M. German, and J. L. Mihelich, U. S. Patent 5,577,546, issued 26 November 1996; also patented in Germany, France, United Kingdom, Italy, and Sweden.
12. "Method for Compacting Compactable Materials and Improved Lubricant for Same," R. M. German, A. Griffo, and T. Potter, U. S. Patent 5,602,350, issued 11 February 1997.
13. "Process of Producing Finely Divided Intermetallic and Ceramic Powders and Products Thereof," K. G. Shaw, D. E. Alman, R. M. Cooper, R. M. German, and K. P. Mc Coy, U. S. Patent 5,608,911, issued 4 March 1997.
14. "Method of Making a Biocompatible Filter," M. L. Bailey, R. Rajkumar, and R. M. German, U. S. Patent 5,651,931, issued 29 July 1997.
15. "A Fuel Filter and Production Process," R. Duffield, R. M. German, T. F. Yen, and R. G. Iacocca, Irish Patent Serial 80515, issued 10 August 1998.
16. "Method of Manufacturing Aluminide Sheet by Thermomechanical Processing of Aluminide Powders," M. R. Hajaligol, C. Scorey, V. K Sikka, S. C. Deevi, G. Fleischhauer, A. C. Lilly, and R. M. German, U. S. Patent 6,030,472, issued 29 February 2000.
17. "Polymer Quenched Prealloyed Metal Powder," M. R. Hajaligol, G. Fleischhauer, and R. M. German, U. S. Patent 6,293,987, issued 25 September 2001.
18. "Thermomechanical Processing of Plasma Sprayed Intermetallic Sheets," M. R. Hajaligol, G. Fleischhauer, and R. M. German, U. S. Patent 6,332,936, issued 25 December 2001.
19. "Powdered Material Rapid Production Tooling Method and Objects Produced Therefrom," R. M. German, T. Weaver, J. Thomas, S. Atre, A. Griffo, U. S. Patent 6,399,018, issued 4 June 2002.
20. "Method of Applying a Hardfacing Material to a Substrate," R. G. Iacocca, K. Sivaraman, A. Lal, and R. M. German, U. S. Patent 6,436,470, issued 20 August

2002.

21. "Fuel Filter and Production Process," R. Duffield, R. M. German, T. F. Yen, and R. G. Iacocca, U. S. Patent 6,458,279, issued 1 October 2002.
22. "Advanced Microelectronic Heat Dissipation Package and Method for Its Manufacture," R. M. German, L. K. Tan, and J. L. Johnson, EU Patent EP1296373, issued 4 October 2006.
23. "Method of Manufacturing Aluminide Sheet by Thermomechanical Processing of Aluminide Powders," M. R. Hajaligol, C. Scorey, V. K. Sikka, S. C. Deevi, G. Fleischhauer, C. A. Lilly, and R. M. German, U. S. Patent 6,660,109, issued 9 December 2003.
24. "Advanced Microelectronic Heat Dissipation Package and Method for Its Manufacture," R. M. German, L. K. Tan, and J. L. Johnson, U. S. Patent 6,935,022, issued 30 August 2005.
25. "Tough Coated Hard Particles Consolidated in a Tough Matrix Material," Randall M. German and John Keane, European Patent Office, E U Patent EP2462083A1, issued 12 March 2012; U. S. Patent 9,187,809 issued 17 November 2015.

Videotapes, Compact Disk, Internet Tutorial Programs

1. A. Lawley and R. M. German, "Powder Metallurgy Science and Technology," Metal Powder Industries Federation, Princeton, NJ, 1990.
2. R. M. German, "Powder Injection Molding - A Textbook Approach," Metal Powder Industries Federation, Princeton, NJ, 1991.
3. R. M. German, "Ferrous Powder Metallurgy," Center for Innovative Sintered Products, Pennsylvania State University, University Park, PA, 2000.
4. R. M. German, "Sintering Concepts and Practices," Center for Innovative Sintered Products, Pennsylvania State University, University Park, PA, 2001.
5. R. M. German, "Powder Injection Molding Tutorial," Innovative Material Solutions, State College, PA, 2003.
6. R. M. German, "Fundamental Manufacturing Processes: Powder Metallurgy," Society of Manufacturing Engineers, Dearborn, MI, 2015.

Articles

1. R. M. German and G. R. St. Pierre, "The High Temperature Thermodynamic Properties of Ni-Ti Alloys," *Metallurgical Transactions,* 1972, vol. 3, pp. 2819-2823.
2. R. M. German, "The Direct Observation of Open Porosity Networks," *Metallography,* 1972, vol. 5, pp. 462-465.
3. R. M. German and Z. A. Munir, "A Correlation Between the Pilling-Bedworth Ratio and the Radius of Curvature of Thin Metallic Substrates with Coherent Thin Oxide Layers," *Oxidation of Metals,* 1974, vol. 8, pp. 123-129.
4. R. M. German, R. W. Mar, and J. C. Hastings, "Sintering Behavior of Boron," *Bulletin of the American Ceramic Society,* 1975, vol. 54, pp. 178-181.
5. R. M. German and V. Ham, "Production of Erbium and Palladium Flakes with Submicron Thicknesses," *International Journal of Powder Metallurgy,* 1975, vol.

11, pp. 97-100.
6. R. M. German and Z. A. Munir, "Morphology Relations During Surface-Transport Controlled Sintering," *Metallurgical Transactions,* 1975, vol. 6B, pp. 289-294.
7. V. P. Madsen and R. M. German, "Quantitative Metallography Using a Television Camera and Laboratory Computer," *Metallography,* 1975, vol. 8, pp. 233-240.
8. R. M. German and Z. A. Munir, "Morphology Relations During Bulk-Transport Sintering," *Metallurgical Transactions,* 1975, vol. 6A, pp. 2229-2234.
9. R. M. German, "Compaction Mechanics of Submicron Palladium Powder," *International Journal of Powder Metallurgy and Powder Technology,* 1975, vol. 11, pp. 169-176.
10. R. M. German and Z. A. Munir, "The Geometry of Sintering Wires," *Journal of Materials Science,* 1975, vol. 10, pp. 1719-1724.
11. R. M. German, "Particle Size Influences on the Strength Relation for Air Sintered Aluminum," *Metallurgical Transactions,* 1975, vol. 6A, pp. 1964-1965.
12. R. M. German and Z. A. Munir, "A Kinetic Model for the Reduction in Surface Area During Initial-Stage Sintering," *Sintering and Catalysis,* G. C. Kuczynski (ed.), Plenum Press, New York, NY, 1975, pp. 249-257.
13. R. M. German and Z. A. Munir, "The Identification of the Initial-Stage Sintering Mechanism, A New Approach," *Sintering and Catalysis,* G. C. Kuczynski (ed.), Plenum Press, New York, NY, 1975, pp. 259-268.
14. R. M. German and Z. A. Munir, "Sintering by Simultaneous Independent Mechanisms," *International Journal of Powder Metallurgy and Powder Technology,* 1976, vol. 12, pp. 37-44.
15. R. M. German and Z. A. Munir, "Identification of the Initial Stage Sintering Mechanism Using Aligned Wires," *Journal of Materials Science,* 1976, vol. 11, pp. 71-77.
16. R. M. German and Z. A. Munir, "Surface Area Reduction During Isothermal Sintering," *Journal of the American Ceramic Society,* 1976, vol. 59, pp. 379-383.
17. R. M. German and V. Ham, "The Effect of Ni and Pd Additions on the Activated Sintering of Tungsten," *International Journal of Powder Metallurgy and Powder Technology,* 1976, vol. 12, pp. 115-125.
18. R. M. German and Z. A. Munir, "Temperature Sensitivity in the Chemically Activated Sintering of Hafnium," *Journal of the Less-Common Metals,* 1976, vol. 46, pp. 333-338.
19. R. M. German, "Fabrication of Low-Permeability Gas Flow Control Devices," *Powder Metallurgy,* 1976, vol. 19, pp. 63-68.
20. R. M. German, "The Strength of Controlled Density Metal Powder Compacts," *Proceedings of the International Powder and Bulk Solids Handling and Processing Conference,* A. S. Goldberg (ed.), Powder Advisory Centre, London, UK, 1976, pp. 6.1-6.10.
21. R. M. German and Z. A. Munir, "Systematic Trends in the Chemically Activated Sintering of Tungsten," *High-Temperature Science,* 1976, vol. 8, pp. 267-280.
22. R. M. German and Z. A. Munir, "Enhanced Low-Temperature Sintering of Tungsten," *Metallurgical Transactions,* 1976, vol. 7A, pp. 1873-1877.
23. R. M. German, "The Sintering of 304L Stainless Steel Powder," *Metallurgical Transactions,* 1976, vol. 7A, pp. 1879-1885.

24. R. M. German and Z. A. Munir, "Rhenium Activated Sintering," *Journal of the Less-Common Metals*, 1977, vol. 53, pp. 141-146.
25. R. M. German, "The Strength Dependence on Porosity for P/M Compacts," *International Journal of Powder Metallurgy and Powder Technology*, 1977, vol. 13, pp. 259-265.
26. R. M. German and Z. A. Munir, "The Sintering of Tantalum with Transition Metal Additions," *Powder Metallurgy*, 1977, vol. 20, pp. 145-150.
27. R. M. German, "Interpretation of Isochronal Temperature Dependent Alumina Sintering Data," *Powder Technology*, 1977, vol. 14, pp. 287-289.
28. R. M. German, "A Technique for Studying Open Porosity Networks," *JEOL News*, 1977, vol. 14, pp. 22-23.
29. R. M. German and Z. A. Munir, "Discussion with Reference to the Sintering of Thoria Gel," *Metallurgical Transactions*, 1977, vol. 8A, pp. 792-793.
30. R. M. German and J. F. Lathrop, "Simulation of Spherical Powder Sintering by Surface Diffusion," *Journal of Materials Science*, 1977, vol. 12, pp. 921-929.
31. R. M. German, J. E. Smugeresky, and C. W. Karfs, "Fracture Path in Hot Isostatically Pressed A286 Superalloy," *Powder Metallurgy International*, 1977, vol. 9, pp. 178-180.
32. Z. A. Munir and R. M. German, "A Generalized Model for the Prediction of Periodic Trends in the Activated Sintering of Refractory Metals," *High-Temperature Science*, 1977, vol. 9, pp. 275-283.
33. R. M. German and J. E. Smugeresky, "Ductility in Hot Isostatically Pressed 250-Grade Maraging Steel," *Metallurgical Transactions*, 1978, vol. 9A, pp. 405-412.
34. J. E. Smugeresky and R. M. German, "Microstructure and Properties of Hot Isostatically Pressed A-286," *Metallurgical Transactions*, 1978, vol. 9A, pp. 253-259.
35. R. M. German, "Grain Growth in Austenitic Stainless Steels," *Metallography*, 1978, vol. 11, pp. 235-239.
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Legislative and Public Briefings

"Overview of the Center for Innovative Sintered Products at Penn State," briefing for the Pennsylvania House of Representatives, Nittany Lion Inn, State College, PA, 14 October 2000.

"Overview of CAVS," briefing for US Senate Appropriations Staff, Center for Advanced Vehicular Systems, Mississippi State University, Starkville, MS, 9 August 2005.

"CAVS Participation in Hurricane Katrina Relief Efforts," briefing for Congressman Roger Wicker and Staff, Swalm College of Chemical Engineering, Mississippi State University, Mississippi State, MS, 23 September 2005.

"Overview of CAVS," briefing for Congressman Charles Pickering and Staff, Center for Advanced Vehicular Systems, Mississippi State University, Starkville, MS, 23 October 2005.

"Comments on Engineering Education," briefing for Institutes of Higher Learning staff, Bagley College of Engineering, Mississippi State University, Mississippi State, MS, 28 October 2005.

"Multiscale Virtual Design and Manufacturing," briefing and reverse site visit response, Blue Ribbon Panel, National Science Foundation, Engineering Research Centers, Washington, DC, 11 January 2006.

Presentations Since 1997

"Powder Metal Processing," presented to the Ingersoll-Rand Technical Council Meeting, Penn State Scanticon, State College, Pennsylvania, 18 March 1997.

"Basics of Ferrous Metallurgy," opening presentation at the Powder Metallurgy of Iron and Steel Short Course, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 3 April 1997.

"Metal Injection Molding," keynote presentation, Near-Net Shapes '97, Deutsche Gesellschaft fuer Materialkunde, Bremen, Germany, 16 April 1997.

"Synthesis and Characteristics of Metal and Ceramic Powders," invited presentation, Powder Characterization Short Course, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 29 April 1997.

"Novel Powder Metallurgy Techniques for Refractory Metals and Hard Materials," invited keynote lecture, Fourteenth International Plansee Seminar, Plansee AG, Reutte, Austria, 14 May 1997.

"PIM Overview," invited presentation, Powder Injection Molding of Metals and Ceramics, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 20 May 1997.

"PIM Tooling," invited presentation, Powder Injection Molding of Metals and Ceramics, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 20 May 1997.

"Advances in High Alloy Sintering Using Supersolidus Liquids," presented at the 1997 Powder Metallurgy and Particulate Materials Technology Conference, Metal Powder Industries Federation, Chicago, Illinois, 30 June 1997.

"Powder Injection Molding," invited presentation, Cummins Engine Corporate Technical Center, Columbus, Indiana, 16 July 1997.

"Overview of PM," invited presentation, Metal Powder Industries Federation Basic Powder Metallurgy Short Course, Penn State Conference Center, State College, Pennsylvania, 11 August 1997.

"Injection Molding Metal Powder," invited presentation, Metal Powder Industries Federation Basic Powder Metallurgy Short Course, Penn State Conference Center, State College, Pennsylvania, 11 August 1997.

"Densification with Transient Supersolidus Liquid Phase Sintering," invited presentation, Hoeganaes Corp.,

Riverton, New Jersey, 19 August 1997.

"Powder Metallurgy Applications," invited presentation, Brush-Wellman Corporate Technology Center, Cleveland, Ohio, 26 August 1997.

"Sintering," invited presentation, Metal Powder Industries Federation Advanced Powder Metallurgy Short Course, Sheraton Grand Hotel, Tampa, Florida, 29 September 1997.

"Program Overview," invited presentation, Practical Powder Injection Molding Tutorial, Innovative Material Solutions, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 1 October 1997.

"Sintering," invited presentation, Practical Powder Injection Molding Tutorial, Innovative Material Solutions, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 1 October 1997.

"Powder Metallurgy Principles," one day short course, Society of Manufacturing Engineers, Holiday Inn Mart Plaza, Chicago, Illinois, 9 October 1997.

"Cost and Selection of Powder Metals," tutorial course, Society of Manufacturing Engineers, Holiday Inn Mart Plaza, Chicago, Illinois, 9 October 1997.

"Metal Injection Molding," one day short course, Society of Manufacturing Engineers, Holiday Inn Mart Plaza, Chicago, Illinois, 10 October 1997.

"Powder Metallurgy Principles," one day short course, Penn State Continuing and Distance Education, Sheraton Gateway Hotel, Los Angeles, California, 20 October 1997.

"Injection Molding of Metals and Ceramics," one day short course, Penn State Continuing and Distance Education, Sheraton Gateway Hotel, Los Angeles, California, 21 October 1997.

"Shaping Metals and Ceramics by Injection Molding," invited seminar, Mechanical Engineering Department, Naval Postgraduate School, Monterey, California, 23 October 1997.

"Sintering with Supersolidus Liquids," seminar, Applied Mechanics and Engineering Sciences Department, University of California - San Diego, La Jolla, California, 28 October 1997.

"Net Shape Forming by Liquid Phase Sintering," invited seminar, Institute-Wide Materials Seminar, Georgia Institute of Technology, Atlanta, Georgia, 4 November 1997.

"Growth and Industry Structure in Injection Molding Metal Powders," invited presentation, World Powder Metallurgy Markets Conference, Gorham Advanced Materials Institute, Atlanta, GA, 5 November 1997.

"Densification of Prealloyed Powders by Supersolidus Sintering," invited seminar, Department of Chemical Engineering and Materials Science, University of California, Davis, California, 10 November 1997.

"New Powder Shaping Concepts and Their Application in Refractory Metals and Hard Materials," invited keynote presentation, 1997 International Conference on Tungsten, Refractory Metals and Alloys, Metal Powder Industries Federation, Orlando, Florida, 17 November 1997.

"Advances in Net Shaping Using Powders," invited seminar, Mechanical, Materials and Aerospace Department, Central Florida University, Orlando, Florida, 18 November 1997.

"Powder Injection Molding Applications to New Materials," invited plenary presentation, Sixth International Conference on Processing and Fabrication of Advanced Materials, Institute of Materials and The Minerals, Metals and Materials Society, Orchard Hotel, Singapore, 24 November 1997.

"The Traditional Powder Metallurgy Process," invited one day short course, Institute of Materials of South East

Asia, Traders Hotel, Singapore, 27 November 1997.

"Injection Molding of Metals and Ceramics," invited one day short course, Institute of Materials of South East Asia, Traders Hotel, Singapore, 28 November 1997.

"Overview of the Technical and Market Advances in Powder Metallurgy and Powder Injection Molding," invited presentation, Powder Metallurgy Association of the Republic of China, National Taiwan University, Taipei, Taiwan, 1 December 1997.

"Injection Molding of Metal Powders," invited seminar, Penn State ASM Chapter, University Park, Pennsylvania, 13 January 1998.

"The PIM Lab at Penn State: Research and Teaching Overview," invited seminar, Smith Tool, Houston, Texas, 9 February 1998.

"Powder Metallurgy," invited one day short course, Society of Manufacturing Engineers, Nashville, Tennessee, 9 March 1998.

"Powder Injection Molding Principles," invited one day short course, Society of Manufacturing Engineers, Nashville, Tennessee, 10 March 1998.

"Injection Molding with Metal Powders and the Latest Developments in PIM Technology," invited presentation, West Penn Chapter APMI International, Ridgway, Pennsylvania, 12 March 1998.

"Overview of Powder Metallurgy," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Lisle, Illinois, 16 March 1998.

"Injection Molding Metal Powders," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Lisle, Illinois, 16 March 1998.

"Tooling and High Speed Tool Steels," invited presentation, Powder Metallurgy of Iron and Steel Short Course, Innovative Material Solutions, State College, Pennsylvania, 25 March 1998.

"Sintering and Atmospheres," invited presentation, Powder Metallurgy of Iron and Steel Short Course, Innovative Material Solutions, State College, Pennsylvania, 25 March 1998.

"A Tutorial Course in the Powder Metallurgy of Tantalum," invited two day short course, arranged by AVX Inc. and Cabot Corp., Imperial Hotel, Torquay, United Kingdom, 30 and 31 March 1998.

"Overview of Stainless Steel Sintering, Effects of Temperature and Atmosphere," invited presentation, Air Products 1998 Technical Symposium on Sintering, Treasure Lake, Dubois, Pennsylvania, 2 April 1998.

"Powder Injection Molding - An Old Yet New Manufacturing Process," invited presentation, Allied-Signal Corporate Technology Center, Morristown, New Jersey, 15 April 1998.

"A Vision of the PIM Industry - Yesterday, Today, and Tomorrow," plenary presentation, PM98 The International Conference on Powder Injection Molding of Metals and Ceramics, Penn State Conference Center, University Park, Pennsylvania, 27 April 1998.

"Overview of Powder Injection Molding," invited presentation, Practical Powder Injection Molding Workshop, The Pennsylvania State University, University Park, Pennsylvania, 30 April 1998.

"Sintering," invited presentation, Practical Powder Injection Molding Workshop, The Pennsylvania State University, University Park, Pennsylvania, 30 April 1998.
"Microstructure Coarsening During Liquid Phase Sintering," presented at the 100th Annual Meeting, American Ceramic Society, Cincinnati, Ohio, 4 May 1998.

"In Situ Strength Evolution of 2H0 P/M Compacts and Its Impact on Sintering Cycle Design," invited presentation, Industrial Applications of Sintering Symposium, American Ceramic Society, Cincinnati, Ohio, 5 May 1998.

"Powder Metallurgy Issues and Innovations," one day short course, Penn State P/M Lab and Innovative Material Solutions, DuBois, Pennsylvania, 11 May 1998.

"Synthesis of Metal and Ceramic Powders," invited presentation, Penn State Powder Characterization Tutorial Program, Atherton Hotel, State College, Pennsylvania, 13 May 1998.

"Rational Atmosphere Selection for Sintering Stainless Steels," invited presentation, Air Products and Chemicals, Allentown, Pennsylvania, 19 May 1998.

"Grain Growth Dependence on the Liquid Content in Liquid Phase Sintered Materials," presented at the Powder Metallurgy and Particulate Materials Technology Conference, Mirage Hotel, Las Vegas, Nevada, 2 June 1998.

"Component Shape Retention during Supersolidus Liquid Phase Sintering," presented at the Powder Metallurgy and Particulate Materials Technology Conference, Mirage Hotel, Las Vegas, Nevada, 2 June 1998.

"A Rationalization of the Powder Injection Molding Process for Stainless Steels Based on Component Features," presented at Powder Metallurgy and Particulate Materials Technology Conference, Mirage Hotel, Las Vegas, Nevada, 3 June 1998.

"New Insights in Sintering Through Microgravity Research," invited general assembly presentation, Powder Metallurgy and Particulate Materials Technology Conference, Mirage Hotel, Las Vegas, Nevada, 4 June 1998.

"Overview of Applications for Powder Metallurgy Processes," invited keynote presentation, PMA'98, Annual Meeting of the Powder Metallurgy Association of South Africa, De Beers Industrial Diamond Technology Center, Johannesburg, South Africa, 7 July 1998.

"Liquid Phase Sintering Densification and Distortion," invited presentation, PMA'98, Annual Meeting of the Powder Metallurgy Association of South Africa, De Beers Industrial Diamond Technology Center, Johannesburg, South Africa, 7 July 1998.

"Powder Injection Molding Process, Successes and Applications," invited keynote presentation, PMA'98, Annual Meeting of the Powder Metallurgy Association of South Africa, De Beers Industrial Diamond Technology Center, Johannesburg, South Africa, 7 July 1998.

"Gravitational Effects on Distortion in Sintering," presented at the 1998 Microgravity Materials Science Conference, Von Braun Center, Huntsville, Alabama, 16 July 1998.

"Gravitational Role in Liquid Phase Sintering," presented at the 1998 Microgravity Materials Science Conference, Von Braun Center, Huntsville, Alabama, 16 July 1998.

"Overview of Powder Metallurgy Processing," invited one day short course, Brush-Wellman Corp., Tucson, Arizona, 4 August 1998.

"Sintering Via Liquid Phases with Prealloyed Powders," invited seminar, Rocketdyne Propulsion and Powder Division, Boeing Corp., Canoga Park, California, 14 August 1998.

"Overview of Powder Metallurgy," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 17 August 1998.

"Injection Molding Metal Powders," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 17 August 1998.

"A Tutorial on Powder Metallurgy," presentation to NASA Marshall Space Flight Center visitation team, The Pennsylvania State University, University Park, Pennsylvania, 27 August 1998.

"Distortion in Liquid Phase Sintering: Scientific Underpinnings," presentation to NASA Marshall Space Flight Center visitation team, The Pennsylvania State University, University Park, Pennsylvania, 27 August 1998.

"Fundamentals of Sintering," invited presentation, Advanced Powder Metallurgy Short Course, Metal Powder Industries Federation, Le Centre Sheraton Hotel, Montreal, Quebec, Canada, 24 September 1998.

"Overview - Injection Molding of Metals and Ceramics," Penn State PIM Tutorial Workshop, Innovative Material Solutions, Nittany Lion Inn, University Park, Pennsylvania, 29 September 1998.

"Sintering of Injection Molded Materials," Penn State PIM Tutorial Workshop, Innovative Material Solutions, Nittany Lion Inn, University Park, Pennsylvania, 29 September 1998.

"Using University Resources to Leverage Industry R&D in PM Technology," invited presentation, 1998 Powder Metallurgy World Congress, European Powder Metallurgy Association, Granada, Spain, 20 October 1998.

"Powder Injection Molding - Process Selection Based on Design Feature Analysis," invited keynote presentation, 1998 Powder Metallurgy World Congress, European Powder Metallurgy Association, Granada, Spain, 21 October 1998.

"Grain Growth Dependence on the Solid-Liquid Ratio in Liquid Phase Sintering," contributed presentation, 1998 Powder Metallurgy World Congress, European Powder Metallurgy Association, Granada, Spain, 21 October 1998.

"Gravitational Role in Distortion during Sintering," contributed presentation, 1998 Powder Metallurgy World Congress, European Powder Metallurgy Association, Granada, Spain, 21 October 1998.

"Novel Heavy Alloys: Composition, Processing, Properties," invited seminar, Army Research Laboratory, Aberdeen Proving Grounds, Maryland, 29 October 1998.

"Stainless Steel Sintering," invited presentation, BOC Gases, St. Marys Country Club, St. Marys, Pennsylvania, 5 November 1998.

"High Temperature Sintering," invited presentation, BOC Gases, St. Marys Country Club, St. Marys, Pennsylvania, 5 November 1998.

"Synthesis, Characterization and Processing of Small Metallic Powders," invited half-day workshop, Fine, Ultrafine and Nano Powders '98 Conference, Crown Plaza Hotel, New York, New York, 8 November 1998.

"Role of Small Powders in Powder Injection Molding: Market and Production Opportunities," invited presentation, Fine, Ultrafine and Nano Powders '98 Conference, Crown Plaza Hotel, New York, New York, 9 November 1998.

"Snapshots of New Technologies in Powder Metallurgy," invited one day seminar, Holiday Inn, Indianapolis, Indiana, 17 November 1998.

"How PM Properties Effect Performance and Failure," invited seminar, Failure Analysis in Powder Metallurgy Seminar, Industrial Technical Education Center, North Central Pennsylvania Regional Planning and Development Commission, Ridgway, Pennsylvania, 19 November 1998.

"PM Failures," invited seminar, Failure Analysis in Powder Metallurgy Seminar, Industrial Technical Education Center, North Central Pennsylvania Regional Planning and Development Commission, Ridgway, Pennsylvania, 19 November 1998.

"Powder Injection Molding Process, Successes and Applications," invited Sauver Award Lecture, Boston Chapter of ASM International, MIT Faculty Club, Cambridge, Massachusetts, 11 February 1999.

"Fabrication of Complex, Net-Shape Components via Sintering of Metal Powders," invited seminar, Department of Mechanical, Industrial and Manufacturing Engineering, Northeaster University, Boston, Massachusetts, 12 February 1999.

"Powder Metallurgy Principles," one day short course, Society of Manufacturing Engineers, WESTEC Conference, Los Angeles, California, 22 March 1999.

"Metal Injection Molding," one day short course, Society of Manufacturing Engineers, WESTEC Conference, Los Angeles, California, 23 March 1999.

"Liquid Phase Sintering Densification and Distortion," invited seminar, Department of Materials Science and Engineering, University of Pittsburgh, Pittsburgh, Pennsylvania, 8 April 1999.

"Particle Size Distribution as a Predictor of Suspension Flow Behavior," invited presentation, Refractories Symposium and Annual Meeting of the American Ceramic Society, Indianapolis, Indiana, 26 April 1999.

"Sintering of Injection Molded Materials," presented at the PIM Tutorial, Penn State University, Innovative Material Solutions, State College, Pennsylvania, 27 April 1999.

"Overview of Powder Injection Molding Technology and Markets," opening presentation, Powder Injection Molding Symposium, Nittany Lion Inn, State College, Pennsylvania, 28 April 1999.

"Control of Dimensional Tolerance in Sintered Cemented Carbides," Corporate Technical Seminar, Kennametal Technology Center, Latrobe, Pennsylvania, 19 May 1999.

"Synthesis of Ceramic and Metal Powders," invited presentation, Powder Analysis and Characterization Seminar, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 25 May 1999.

"Powder Injection Molding, An Overview of Growth Opportunities," invited presentation, Powderflo User's Group, Allied-Signal Technology Center, Morristown, New Jersey, 25 May 1999.

"Strength Loss and Densification in Liquid Phase Sintering," seminar, Hoeganaes Corp., Cinnaminson, New Jersey, 8 June 1999.

"What Does the Future Hold for Materials," invited presentation, Sulzer-Metco, Westbury, New York, 9 June 1999.

"Gravity-Induced Dimensional Nonuniformity Under Sintering Taking into Consideration Grain Segregation," presented at the 1999 International Conference on Powder Metallurgy and Particulate Materials, Vancouver, British Columbia, Canada, 21 June 1999.

"Comparison of Conventional Sintering and Microwave Sintering of Two Ferrous Alloys," presented at the 1999 International Conference on Powder Metallurgy and Particulate Materials, Vancouver, British Columbia, Canada, 21 June 1999.

"*In Situ* Strength Evolution of PM Compacts in Response to Combined Effects of Time and Temperature During Sintering," presented at the 1999 International Conference on Powder Metallurgy and Particulate Materials, Vancouver, British Columbia, Canada, 22 June 1999.

"Alloying Effects on the Sintered Density of a Molding Grade of Iron Powder," presented at the 1999 International Conference on Powder Metallurgy and Particulate Materials, Vancouver, British Columbia, Canada, 23 June 1999.
"Academic Perspective on Powder Metallurgy and Particulate Materials Challenges for the 21st Century," invited presentation, Special Interest Program, 1999 International Conference on Powder Metallurgy and Particulate Materials, Vancouver, British Columbia, Canada, 23 June 1999.

"Strength Loss and Distortion in Liquid Phase Sintering," presented at the 1999 International Conference on Powder

Metallurgy and Particulate Materials, Vancouver, British Columbia, Canada, 24 June 1999.

"Metal Injection Molding," invited seminar, Hawk Corporation Technical Manager's Meeting, Cleveland, Ohio, 15 July 1999.

"Overview of Powder Metallurgy and High Pressure Compaction," invited seminar, GE Superabrasives, Worthington, Ohio, 29 July 1999.

"Overview of Powder Metallurgy," invited presentation, Powder Metallurgy Basic Short Course, Metal Powder Industries Federation, Penn Stater Conference Center, University Park, Pennsylvania, 2 August 1999.

"Injection Molding Metal Powder," invited presentation, Powder Metallurgy Basic Short Course, Metal Powder Industries Federation, Penn Stater Conference Center, University Park, Pennsylvania, 2 August 1999.

"Sintering Stress and Strength Evolution in Sintering: The Important Role of Particle Size," invited presentation, 44th Sagamore Materials Research Conference, organized by the Army Research Laboratory, Tidewater Inn, Easton, Maryland, 25 August 1999.

"Net-Shape Engineering With Metal Powders," department seminar, Engineering Science and Mechanics Department, The Pennsylvania State University, University Park, Pennsylvania, 1 September 1999.

"Net-Shape Forming Based on Powders," invited Nanyang Professor Public Lecture, Nanyang Technological University, Singapore, 30 September 1999.

"Powder Injection Molding: Feedstock Design," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 1 October 1999.

"Powder Injection Molding: Molding Considerations," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 4 October 1999.

"Powder Injection Molding: Thermo-Mechanical Processing," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 6 October 1999.

"Powder Injection Molding as an Alloy Engineering Technology," invited Nanyang Professor Public Lecture, Nanyang Technological University, Singapore, 7 October 1999.

"Sintering of Injection Molded Materials," invited seminar presentation, Powder Injection Molding Tutorial, Innovative Material Solutions, Nittany Lion Inn, The Pennsylvania State University, University Park, Pennsylvania, 12 October 1999.

"The Powder Injection Molding Process and Some Applications," invited seminar, Department of Materials Science and Engineering, Lehigh University, Bethlehem, Pennsylvania, 19 October 1999.

"Design and Fabrication of Complex Components," invited one day presentation, Powder Injection Molding Seminar, Mathson Industries, Troy, Michigan, 20 October 1999.

"Fundamentals of Sintering," invited seminar, Advanced Powder Metallurgy Short Course, Metal Powder Industries Federation, Pittsburgh, Pennsylvania, 27 October 1999.

"Alloy Effects on the Properties of Liquid Phase Sintered Fe, C, B Compositions," presented at Sintering '99 The Second International Conference on the Science, Technology and Applications of Sintering, Pennsylvania State University, University Park, Pennsylvania, 1 November 1999.

"Strength Loss and Distortion in Liquid Phase Sintering," presented at Sintering '99 The Second International Conference on the Science, Technology and Applications of Sintering, Pennsylvania State University, University Park, Pennsylvania, 2 November 1999.

"Strategies for Controlling Shape Distortion and Dimensional Precision in Liquid Phase Sintered Refractory Materials," presented at Sintering '99 The Second International Conference on the Science, Technology and Applications of Sintering, Pennsylvania State University, University Park, Pennsylvania, 2 November 1999.

"Injection Molding Metals and Ceramics," one day seminar, TechTrax, Chicago, Illinois, 8 November 1999.

"Innovations in Sintering, New Products and Processes," invited presentation, West Penn Chapter APMI International, Ridgway, Pennsylvania, 11 November 1999.

"Innovations in Sintering," invited presentation, Forming Technology Workshop, Advanced Technology Program, National Institute of Standards and Technology, San Jose, California, 16 November 1999.

"Innovations in Sintered Materials," invited lecture, Japan Institute of Metals, Tohoku University, Sendai, Japan, 26 November 1999.

"Status Report on Powder Injection Molding and Future Opportunities," invited seminar, Injex Division, Seiko-Epson Corp., Suwa, Nagano-ken, Japan, 30 November 1999.

"Innovations in Sintering," invited plenary lecture, Japan Research Institute of Materials Technology Annual Meeting, Science University of Tokyo, Noda, Japan, 2 December 1999.

"Innovations in Sintered Materials," invited lecture, Hitachi Powder Metals Co., Matsudo, Japan, 3 December 1999.

"Powder Injection Molding Process, Successes and Applications," invited presentation, Combined Meeting of Cleveland Chapter ASM International and APMI International, Cleveland, Ohio, 6 December 1999.

"Gravitational Role in Sintering," program review, National Aeronautics and Space Center, Marshall Space Flight Center, MSFC, Alabama, 4 February 2000.

"Innovations in Sintering," invited seminar, Philip Morris Research Center, Richmond, VA, 25 February 2000.

"Strength Evolution in Sintering as a Basis for Distortion Control," presented at PIM 2000, International Conference on Powder Injection Molding of Metals, Ceramics, and Cemented Carbides, Penn Stater Conference Center, University Park, Pennsylvania, 21 March 2000.

"Research Productivity and the Value to the PIM Market," presented at PIM 2000, International Conference on Powder Injection Molding of Metals, Ceramics, and Cemented Carbides, Penn Stater Conference Center, University Park, Pennsylvania, 22 March 2000.

"Post-Molding Processing, Debinding and Sintering," invited presentation, Practical Powder Injection Molding Tutorial Workshop, Penn Stater Conference Center, University Park, Pennsylvania, 23 March 2000.

"Overview of PIM," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Indianapolis, Indiana, 27 March 2000.

"Injection Molding Metal Powders," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Indianapolis, Indiana, 27 March 2000.

"Innovations in Sintering and Sintered Materials," invited seminar, Frontiers in Materials, Materials Research Institute, The Pennsylvania State University, University Park, Pennsylvania, 28 March 2000.

"Sintering Theory," invited one day short course, GKN Sinter Metals, DuBois, Pennsylvania, 26 April 2000.

"Rational Selection of Sintering Atmospheres for Stainless Steels," technical seminar, Air Products and Chemicals, Allentown, Pennsylvania, 18 May 2000.

"The Synthesis and Production of Metal and Ceramic Powders," invited presentation, Powder Characterization Short Course, The Pennsylvania State University, University Park, Pennsylvania, 23 May 2000.

"The Status of Metal Powder Injection Molding: A PM Market Alternative to Automotive," invited presentation, International Conference on Powder Metallurgy and Particulate Materials, New York, New York, 31 May 2000.

"Sintering of Prealloyed Powders," invited presentation, International Conference on Powder Metallurgy and Particulate Materials, New York, New York, 31 May 2000.

"Strength Evolution in Sintering as a Basis for Distortion Control," contributed presentation, International Conference on Powder Metallurgy and Particulate Materials, New York, New York, 1 June 2000.

"The Gravitational Role in Liquid Phase Sintering," presented at Microgravity Materials Science Conference, Huntsville, Alabama, 8 June 2000.

"Fundamentals of Ferrous Metallurgy, Applications to Powder Metallurgy," one day short course organized by Penn State DuBois, Industrial Technology Center, Ridgway, Pennsylvania, 9 June 2000.

"Strength Evolution in Sintering," invited seminar, Department of Mechanical and Production Engineering, Nanyang Technological University, Yunnum Campus, Singapore, 17 July 2000.

"Innovations in Sintering," Nanyang Professor Invited Public Lecture, Nanyang Technological University, Yunnum Campus, Singapore, 20 July 2000.

"Professional Strategies in Materials Research," invited seminar, Department of Mechanical and Production Engineering, Nanyang Technological University, Yunnum Campus, Singapore, 24 July 2000.

"Overview of Powder Metallurgy," invited seminar, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Penn Stater Conference Center, State College, Pennsylvania, 31 July 2000.

"Metal Powder Injection Molding," invited seminar, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Penn Stater Conference Center, State College, Pennsylvania, 31 July 2000.

"Innovations in Sintering and Sintered Materials," invited Technical Seminar, Alcoa Technical Center, Alcoa Center, Pennsylvania, 16 August 2000.

"Powder Metallurgy Principles," one day short course, Society of Manufacturing Engineers, Nashville, Tennessee, 12 September 2000.

"Metal Injection Molding Principles," one day short course, Society of Manufacturing Engineers, Nashville, Tennessee, 13 September 2000.

"Thermal Processing, Debinding and Sintering," invited presentation, Practical Powder Injection Molding Workshop, Innovative Material Solutions, Atherton Hotel, State College, Pennsylvania, 18 September 2000.

"Sintering Research and the Center for Innovative Sintered Products at Penn State," invited presentation, FMI Corp., Cortland, New York, 26 September 2000.
"Center for Innovative Sintered Products: An Industry Directed Academic Program," keynote lecture, Fifty Fifth Annual Forum, Pennsylvania Ceramics Association, Penn Stater Conference Center Hotel, University Park, Pennsylvania, 29 September 2000.

"Densification of Traditional Ferrous Powders by High Temperature Sintering," invited presentation at the 20th Heat Treating Society Conference and Show, Saint Louis, MO, 10 October 2000.

"Innovations in Sintering," invited presentation at the ASM Materials Solutions Conference and Exposition, Saint

Louis, MO, 10 October 2000.

"Growth in Powder Metallurgy through Targeted Innovative Developments," invited keynote presentation, Deutsche Keramische Gesellschaft, Internationales Congresszentrum Munich, Munich, Germany, 17 October 2000.

"Powder Injection Molding: Process, Successes and Applications," invited seminar, Quad City ASM International Meeting, Moline, Illinois, 24 October 2000.

"Ferrous Powder Metallurgy," one day short course organized by Penn State DuBois, Industrial Technology Center, Ridgway, Pennsylvania, 2 November 2000.

"Overview of Powder Injection Molding, Industry Structure, Applications, and Engineering Window," invited seminar, Emerson Electric Corp., The Pennsylvania State University, University Park, Pennsylvania, 3 November 2000.

"Final Density and Dimension Predictions Based on Control of Strength Evolution in Sintering," contributed presentation 2000 Powder Metallurgy World Congress, Japan Powder Metallurgy Association, Kyoto, Japan, 13 November 2000.

"Powder Injection Molding Process, Successes, Applications and Growth Prospects," invited presentation, 2000 Powder Metallurgy World Congress, Japan Powder Metallurgy Association, Kyoto, Japan, 15 November 2000.

"Models and Process Design for Supersolidus Sintering to Full Density," invited presentation, International Workshop on Advanced Powder Metallurgy, The Iron and Steel Institute of Japan and Japan Society of Powder and Powder Metallurgy, Kyoto, Japan, 17 November 2000.

"Overview of the Technology and Markets in Powder Injection Molding," invited opening presentation, Metal Injection Molding Conference, Society of Manufacturing Engineers, Ann Arbor, Michigan, 5 December 2000.

"Metal Powder Injection Molding," invited seminar, Ridge Tool, Elyria, Ohio, 15 December 2000.

"Strength Evolution in Debinding and Sintering," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 16 January 2001.

"A Performance Study of Production Tooling Obtained by a Powder Metallurgy Route," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 18 January 2001.

"Comparative Evaluation of Sintered Net-Shaped Engineered Materials and Research Directions," Nanyang Professorship Invited Public Lecture, Nanyang Technological University, Singapore, 18 January 2001.

"Liquid Phase Sintering Distortion and Observations on Gravity Effects on Materials Processing," invited seminar, South East Asia Institute of Materials, Singapore, 22 January 2001.

"Powder Injection Molding Tutorial," half-day short course, PIM 2001 International Symposium on Powder Injection Molding, Innovative Material Solutions and Center for Innovative Sintered Products, Orlando, Florida, 28 February 2001.

"Best Practices in Powder Injection Molding," invited presentation, PIM 2001 International Symposium on Powder Injection Molding, Innovative Material Solutions and Center for Innovative Sintered Products, Orlando, Florida, 2 March 2001.

"Sintering Large Ferrous Powders to Full Density," invited seminar, Technology Center, Rio Tinto Iron and Titanium, Tracy, Quebec, Canada, 9 March 2001.

"Ferrous Powder Metallurgy," one day short course organized by Penn State DuBois, Industrial Technology Center, Ridgway, Pennsylvania, 14 March 2001.

"Processing with Polymer Melts," invited presentation, Understanding Binders and Lubricants in Powder Processing, Innovative Material Solutions and Center for Innovative Sintered Products, Nittany Lion Inn, Penn State University, University Park, Pennsylvania, 19 March 2001.

"Overview of Powder Metallurgy," invited seminar, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Cleveland, Ohio, 26 March 2001.

"Metal Powder Injection Molding," invited seminar, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Cleveland, Ohio, 26 March 2001.

"Advances in Metal Powder Injection Molding: Designs, Applications, and Properties," invited presentation, Bergmann Seminar Series, ASM Milwaukee Chapter, Milwaukee, Wisconsin, 4 April 2001.

"Models and Process Design for Supersolidus Sintering to Full Density," invited seminar, Materials Science Program, University of Wisconsin, Madison, Wisconsin, 5 April 2001.

"Feat Molding Processing, Debinding and Sintering," invited presentation, Powder Injection Molding Tutorial, Innovative Material Solutions, State College, Pennsylvania, 12 April 2001.

"Sintering Concepts and Practices," one day tutorial seminar, organized by Penn State DuBois and Center for Innovative Sintered Products, Industrial Technology Center, Ridgway, Pennsylvania, 4 May 2001.

"An Analysis of Process Variations Leading to Dimensional Variations in Sintering," invited presentation at the 2001 Powder Metallurgy and Particulate Materials Conference, Metal Powder Industries Federation, New Orleans, Louisiana, 14 May 2001.

"Best Practices in Powder Injection Molding," presented at the 2001 Powder Metallurgy and Particulate Materials Conference, Metal Powder Industries Federation, New Orleans, Louisiana, 16 May 2001.

"The Market for Powder Injection Molding," presented at the 2001 Powder Metallurgy and Particulate Materials Conference, Metal Powder Industries Federation, New Orleans, Louisiana, 16 May 2001.

"The Status of Titanium Powder Injection Molding," invited presentation at the 2001 Powder Metallurgy and Particulate Materials Conference, Metal Powder Industries Federation, New Orleans, Louisiana, 17 May 2001.

"Microstructure Manipulations to Attain Densification without Distortion in Liquid Phase Sintering," presented at the 2001 Powder Metallurgy and Particulate Materials Conference, Metal Powder Industries Federation, New Orleans, Louisiana, 17 May 2001.

"Presintering Effects on Tungsten Heavy Alloy Liquid Phase Sintering," presented at the 2001 Powder Metallurgy and Particulate Materials Conference, Metal Powder Industries Federation, New Orleans, Louisiana, 17 May 2001.

"Unique Opportunities in Powder Injection Molding of Refractory and Hard Materials," presented at the 15th International Plansee Seminar, Metallwerk Plansee, Reutte, Austria, 30 May 2001.

"Shape Distortion and Dimensional Precision in Tungsten Heavy Alloy Liquid Phase Sintering," presented at the 15th International Plansee Seminar, Metallwerk Plansee, Reutte, Austria, 31 May 2001.

"Synthesis of Ceramic and Metal Powders," invited presentation, Powder Analysis and Characterization Workshop, Center for Innovative Sintered Products, Particulate Materials Center, and Innovative Material Solutions, Pennsylvania State University, State College, Pennsylvania, 18 June 2001.

"Overview of Powder Metallurgy," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 30 July 2001.

"Injection Molding Metal Powder," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 30 July 2001.

"Mechanical Testing of Green and Sintered Parts," invited presentation, Met Lab - Metals Laboratory Workshop, Center for Innovative Sintered Products, Pennsylvania State University, University Park, Pennsylvania, 8 August 2001.

"Sintering Concepts - Part 1, Solid-State Sintering," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 17 August 2001.

"Sintering Concepts - Part 2, Liquid Phase Sintering," invited seminar, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore, 17 August 2001.

"Computer Modeling of Net-Shape Processes," Nanyang Professor Public Lecture, Nanyang Technological University, Singapore, 20 August 2001.

"Microgravity Materials Processing," Forty-Fifth Anniversary Distinguished Speaker Series, River Valley High School, Singapore, 21 August 2001.

"Powder Injection Molding of Difficult to Process Materials," Nanyang Professor Public Lecture, Nanyang Technological University, Singapore, 28 August 2001.

"Overview of Powder Injection Molding," keynote address, Transforming Metal Powder into Manufacturing Solutions Seminar, Science Park, Singapore, 29 August 2001.

"Metal Powder Injection Molding - Designs, Applications, and Properties," invited seminar, Advanced Materials Technologies, Singapore Technologies, Singapore, 29 August 2001.

"Sintering Concepts and Practices," one day seminar, Penn State DuBois Outreach Program, Industrial Technical Educational Center, Ridgway, Pennsylvania, 26 September 2001.

"Powder Injection Molding - Designs, Materials, Applications, Properties, and Successes," invited presentation, Young Members Night, Philadelphia Liberty Bell Chapter, ASM International, Willow Grove, Pennsylvania, 18 October 2001.

"Sintering Concepts and Practice for PIM," invited presentation, International Symposium on Powder Injection Molding, 2001 Materials Solutions Conference, ASM International, Indianapolis, Indiana, 6 November 2001.

"Innovative Designs Possible in Injection Molded Metal Powder Structures," invited presentation, International Symposium on Powder Injection Molding, 2001 Materials Solutions Conference, ASM International, Indianapolis, Indiana, 6 November 2001.

"Computer Modeling of Net-Shape Processes," department seminar, Engineering Science and Mechanics Department, Pennsylvania State University, University Park, Pennsylvania, 14 November 2001.

"Powder Metallurgy of Iron and Steel," invited two day seminar, Grand Pacific Hotel, National Metal and Materials Technology Center, Bangkok, Thailand, 13 and 14 December 2001.

"Strength Evolution in Sintering as a Basis for Distortion Control," technical seminar, North American Hoganas, Hollsopple, Pennsylvania, 8 February 2002.

"Fuel Injectors, Sensors, and Actuators Manufactured by Bi-Metal Powder Injection Molding," presented at the PIM Applications for Powertrain Program, 2002 Society of Automotive Engineers World Congress, Cobo Hall, Detroit, Michigan, 4 March 2002.

"Fundamentals of Ferrous Powder Metallurgy," one day short course, Industrial Technical Educational Center,

Ridgway, Pennsylvania, 6 March 2002.

"Analysis of PIM Processing of Difficult Materials," contributed presentation, PIM 2002 International Conference on Injection Molding Metals and Ceramics, San Diego, California, 20 March 2002.

"Powder Injection Molding Tutorial," one day short course, Innovative Materials Solutions, San Diego, California, 21 March 2002.

"Strength Evolution Concepts in Sintering," technical seminar, Osram Sylvania, Towanda, Pennsylvania, 5 April 2002.

"Trends Impacting Technical Education," invited presentation, Austrian R&D: The Global Game, Austrian Research Centers in North America, Penn Stater Hotel, State College, Pennsylvania, 12 April 2002.

"Failure Analysis and Troubleshooting with Metallography," invited presentation, Metallography and Microstructural Analysis Short Course, Center for Innovative Sintered Products, State College, Pennsylvania, 17 April 2002.

"Research in Sintering Theory, Densification and Distortion," technical seminar, Corporate Technology Center, Kennametal, Latrobe, Pennsylvania, 26 April 2002.

"Feed Molding Processing, Debinding and Sintering," invited seminar, Powder Injection Molding Tutorial, Center for Innovative Sintered Products and Innovative Material Solutions, Atherton Hotel, State College, Pennsylvania, 29 April 2002.

"Designing for Powder Injection Molding," invited seminar, Powder Injection Molding Tutorial, Center for Innovative Sintered Products and Innovative Material Solutions, Atherton Hotel, State College, Pennsylvania, 29 April 2002.

"Strength Evolution Concepts During Sintering Densification," technical seminar, Corporate Technology Center, Hoeganaes Corp., Cinnaminson, New Jersey, 3 May 2002.

"Binder Additives for Powder Processing," presented at the Understanding Binders and Lubricants in Powder Processing Workshop, Austrian Research Centers - Seibersdorf Research, Hotel Schloss Weikersdorf, Baden, Austria, 13 May 2002.

"Processing with Polymer Melts," invited presentation at the Understanding Binders and Lubricants in Powder Processing Workshop, Austrian Research Centers - Seibersdorf Research, Hotel Schloss Weikersdorf, Baden, Austria, 13 May 2002.

"Plastic Processing of Particulate Solids," invited seminar, Pfizer Global Research and Development, Groton, Connecticut, 14 June 2002.

"Microstructural Impact on Fatigue Behavior in Powder Metallurgy and Implications with Respect to Powder Selection and Sintering Cycles," invited presentation at the Special Interest Program, World Congress of Powder Metallurgy and Particulate Materials, APMI-Metal Powder Industries Federation, Orlando, Florida, 17 June 2002.

"Effect of Inhomogeneity on Dimensional Precision in Liquid Phase Sintering," presented at the World Congress of Powder Metallurgy and Particulate Materials, APMI-Metal Powder Industries Federation, Orlando, Florida, 17 June 2002.

"Critical Overview of Sintering Computer Simulations," presented at the World Congress of Powder Metallurgy and Particulate Materials, APMI-Metal Powder Industries Federation, Orlando, Florida, 18 June 2002.

"Opportunities in Sintered Products - Lets See Casting and Machining Do This," invited presentation at the Special Interest Program, World Congress of Powder Metallurgy and Particulate Materials, APMI-Metal Powder Industries

Federation, Orlando, Florida, 18 June 2002.

"Protocol for Developing Sintering Cycles for Difficult Materials," presented at the World Congress of Powder Metallurgy and Particulate Materials, APMI-Metal Powder Industries Federation, Orlando, Florida, 19 June 2002.

"Understanding the Role of Atmospheres for Polymer Burnout and Sintering of Stainless Steel Components," invited presentation at the Special Interest Program, World Congress of Powder Metallurgy and Particulate Materials, APMI-MPIF, Orlando, Florida, 19 June 2002.

"Gravitational Effects on Distortion in Sintering," invited presentation at the 2002 Materials Science Conference, Physical Sciences Division, National Aeronautics and Space Administration, Huntsville, Alabama, 25 June 2002.

"Overview of Powder Metallurgy," invited presentation at the Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 15 July 2002.

"Metal Powder Injection Molding," invited presentation at the Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 15 July 2002.

"Markets and Technology of Metal Powder Injection Molding," invited presentation, Osram Sylvania Business Development Team, Center for Innovative Sintered Products, Pennsylvania State University, State College, Pennsylvania, 25 July 2002.

"Global and Local View of Metal Powder Injection Molding," invited presentation, GKN Corporate Technology Board, GKN Sinter Metals, Romulus, Michigan, 29 July 2002.

"Sintering Concepts: Fundamentals of Sintering," invited presentation, Advanced Powder Metallurgy Short Course, Metal Powder Industries Federation, Philadelphia, Pennsylvania, 11 September 2002.

"Sintering Optimization for Powder Injection Molding of Bi-Metallic Components," invited keynote presentation, Tenth Materials and Processing Conference, Japan Society of Mechanical Engineers and American Society of Mechanical Engineers International Conference, Honolulu, Hawaii, 16 October 2002.

"Post Molding Processing: Debinding and Sintering Science," invited presentation, Practical Powder Injection Molding Tutorial, Innovative Material Solutions, State College, Pennsylvania, 22 October 2002.

"Designing for Powder Injection Molding," invited presentation, Practical Powder Injection Molding Tutorial, Innovative Material Solutions, State College, Pennsylvania, 22 October 2002.

"Sintering Concepts and Practices," invited one day seminar, Penn State DuBois Continuing Education, Industrial Technology Educational Center, Ridgway, Pennsylvania, 6 November 2002.

"Sintering Concepts and Their Application in Powder Metallurgy," invited one day seminar, Fall Trinity Corporation, Cortland, New York, 22 November 2002.

"Sintering Concepts - Atomistic Mass Flow, Microstructure Evolution, and Macroscopic Property Changes," invited presentation American Geophysical Union Fall 2002 Meeting, San Francisco, California, 8 December 2002.

"How the System Works," invited presentation, Powder Metallurgy and Particulate Materials Roadmap Collaboration Workshop, Metal Powder Industries Federation Roadmap Strategy Board, Hyatt Regency, Pittsburgh, Pennsylvania, 29 January 2003.

"Powder Injection Molding – Application to Ceramics," invited presentation, Osram Sylvania Lighting Research Center, Cherry Hill, Beverley, Massachusetts, 5 February 2003.

"The Center for Innovative Sintered Products at Penn State," invited presentation, Spang Magnetics, Pittsburgh, Pennsylvania, 4 March 2003.

"CISP Research on Full Density Ferrous Powder Metallurgy," presented at Technical Center, AMES S.A., Saint Vicenc dels Horts, Spain, 7 March 2003.

"Overview of Powder Metallurgy," half-day invited short course, Department of Materials, Universidad Carlos III de Madrid, Leganes, Spain, 10 March 2003.

"Powder Injection Molding," half-day invited short course, Department of Materials, Universidad Carlos III de Madrid, Leganes, Spain, 11 March 2003.

"Sintering Theory," half-day invited short course, Department of Materials, Universidad Carlos III de Madrid, Leganes, Spain, 12 March 2003.

"Powder Injection Molding Tutorial," invited one day short course, Innovative Material Solutions, Penn State Conference Center, State College, Pennsylvania, 16 March 2003.

"Design Paradigm Concepts based on User Needs," presented at PIM2003 International Conference on Powder Injection Molding of Metals, Ceramics and Carbides, Penn State Conference Center, State College, Pennsylvania, 17 March 2003.

"An Economic Model for PIM Component Production," presented at PIM2003 International Conference on Powder Injection Molding of Metals, Ceramics and Carbides, Penn State Conference Center, State College, Pennsylvania, 18 March 2003.

"Evolution of PIM Sintering Models for Finite Element Size and Shape Prediction," presented at PIM2003 International Conference on Powder Injection Molding of Metals, Ceramics and Carbides, Penn State Conference Center, State College, Pennsylvania, 19 March 2003.

"Green Body Heterogeneities and the Difficulties They Present to Computerized Sintering Models," invited presentation, Symposium on Characterization for Process Control in 21st Century Ceramic Manufacturing, 105th Annual Meeting of the American Ceramic Society, Nashville, Tennessee, 30 April 2003.

"Powder Injection Molding: Where We Are and Where We Are Going," invited presentation, Kinetics Inc., Wilsonville, Oregon, 14 May 2003.

"Sintering Concepts and Their Applications in Powder Metallurgy," presented to the Research Experience for Undergraduates Program, Pennsylvania State University, University Park, Pennsylvania, 30 May 2003.

"Sintering Simulation Experiments of Large MIM Components in a Pusher Furnace," presented at the 2003 Powder Metallurgy and Particulate Materials Conference, Las Vegas, Nevada, 9 June 2003.

"Economic Batch Size Impact on the Cost of PIM Products," presented at the 2003 Powder Metallurgy and Particulate Materials Conference, Las Vegas, Nevada, 9 June 2003.

"Design Guide for PIM - Simplified Rules," presented at the 2003 Powder Metallurgy and Particulate Materials Conference, Las Vegas, Nevada, 9 June 2003.

"Ceramics, Composition-Structure-Property-Shaping Technologies: A Quick Designer's Guide," invited short course, Hewlett Packard, Corvallis, Oregon, 19 June 2003.

"Powder Injection Molding, An Emerging Process," technical seminar, Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico, 23 June 2003.

"Powder Injection Molding, An Emerging Process," technical seminar, Advanced Materials Laboratory, Sandia National Laboratories, Albuquerque, New Mexico, 24 June 2003.

"Some Problems in Microgravity Sintering," invited presentation, In-Space Fabrication and Repair Workshop, National Aeronautics and Space Administration, Marshall Institute, Madison, Alabama, 8 July 2003.

"Overview of Powder Metallurgy," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Penn Stater Conference Center Hotel, State College, Pennsylvania, 14 July 2003.

"Metal Powder Injection Molding," invited presentation, Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Penn Stater Conference Center Hotel, State College, Pennsylvania, 14 July 2003.

"Sintering Concepts," invited two day short course presentation, South African Powder Metallurgy Association, DeBeers Technical Center, Johannesburg, South Africa, 22-23 July 2003.

"Powder Injection Molding - An Emerging Process," invited presentation, Element Six Technical Center, Springs, South Africa, 24 July 2003.

"Powder Injection Molding Products and Images," invited presentation, Marketing Conference, Advanced Materials Technologies, Singapore, 29 July 2003.

"Rationalization of Function, Design, and Process Using Powder Injection Molding," invited keynote presentation, Technology Seminar 2003, Swissotel Merchant Court Hotel, Advanced Materials Technologies, Singapore, 1 August 2003.

"Designing for PIM: A Quick Tutorial," invited half-day short course, Swissotel Merchant Court Hotel, Advanced Materials Technologies, Singapore, 1 August 2003.

"Powder Injection Molding - An Emerging Process," invited presentation, Corning Sullivan Park Corporate Technology Center, Corning, New York, 8 August 2003.

"An Update on the Theory of Supersolidus Liquid Phase Sintering," invited plenary session presentation, Sintering 2003 - The Third International Conference on the Science, Technology and Applications of Sintering, Materials Research Institute and Center for Innovative Sintered Products, Penn Stater Conference Center, State College, Pennsylvania, 15 September 2003.

"Strength Evolution in Debinding and Sintering," presented at Sintering 2003 - The Third International Conference on the Science, Technology and Applications of Sintering, Materials Research Institute and Center for Innovative Sintered Products, Penn Stater Conference Center, State College, Pennsylvania, 15 September 2003.

"Gravity Effects on Liquid Phase Sintering Distortion Observations," presented at Sintering 2003 - The Third International Conference on the Science, Technology and Applications of Sintering, Materials Research Institute and Center for Innovative Sintered Products, Penn Stater Conference Center, State College, Pennsylvania, 15 September 2003.

"Gravitational Effects on Distortion in Sintering," presented at Teledyne Brown Engineering, Huntsville, Alabama, 1 October 2003.

"High Performance Powder Metallurgy - Myths and Realistic Opportunities," invited keynote presentation, 2003 Materials Solutions Conference, ASM International, Pittsburgh, Pennsylvania, 13 October 2003.

"Powder Injection Molding Tutorial," invited one day seminar, Borg-Warner and Fell Corporation, Cortland, New York, 1 December 2003.

"Sintering Measurement Techniques," Sintering Mechanics Seminar, Mechanical Engineering Department, San Diego State University, San Diego, California, 20 January 2004.

"Current Techniques in Powder Metallurgy: Liquid Phase Sintering in DOD Applications," invited presentation, Air Force Research Laboratory, Edwards Air Force Base, California, 26 January 2004.

"Modeling Densification and Distortion in Liquid Phase Sintering," invited seminar, Rockwell Scientific, Thousand Oaks, California, 17 February 2004.

"Engineering Education - Some Comments," commencement speech, Protocolo del Solemne Acto del día de la Universidad del Curso 2003/2004, Investidura Como Doctor Honoris Causa de Prof. Dr. D. Randall German, Universidad Carlos III de Madrid, Getafe, Madrid, Spain, 20 February 2004.

"Thermal Management and Packaging Design Using Powder Injection Molding," invited seminar, Sun Microsystems, San Diego, California, 11 March 2004.

"Powder Injection Molding Tutorial," one day short course, Rosen Plaza Hotel, Orlando, Florida, Innovative Material Solutions, 21 March 2004.

"Low-Cost In-Line Powderflo Processing, a Feasibility Study," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 22 March 2004 (with R. C. Morris, T. Pelletiers).

"Adaptation of Master Sintering Curve to Sintering of Injection Molded Tungsten Heavy Metal Alloys," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 22 March 2004 (with S. H. Chung, S. J Park, P. Suri, N. Erhardt).

"Multiple Axis In Situ Monitoring of Polymer Burnout in Powder Compacts," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 23 March 2004 (with R. Paloseski, C. Binet).

"Comparison of the Impact Properties of Sintered and Wrought 17-4 PH Stainless Steel," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 23 March 2004 (with B. Psmarslok, P. Suri).

"Development of Titanium Feedstock for Powder Injection Molding," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 23 March 2004 (with S. J Park, S. H. Chung, Y. S. Won, S. V. Atre, Y. X. Wu).

"Study on the Effects of Liquid Volume Fraction on Sintering Behavior of W-Ni-Fe Alloy," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 23 March 2004 (with S. H. Chung, Y. S. Won, P. Suri, R. Bollina).

"Effect of Copper Powder Characteristics on the Processing of MIM Heat Sinks," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 24 March 2004 (with J. L. Johnson, P. Suri).

"Cost Modeling and Sensitivity Analysis for PIM Components," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 24 March 2004 (with T. Pelletiers).

"Large Metallic Parts by PIM," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 23 March 2004 (with D. Blaine, P. Suri, S. Das, J LaSalle).

"Master Sintering Curve Construction Software and Its Application," presented at PIM 2004 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Orlando, Florida, 23 March 2004 (S. J Park, S. H. Chung, D. Blaine, P. Suri).

"Designs, Data, Needs, and Perception Problems - How the Users are Guiding PIM Research at Penn State," invited presentation, Parmatech Corporation, Petaluma, California, 8 April 2004.

"Liquid Phase Sintering, From Basics to Applications," invited seminar, Chemical and Materials Engineering,

University of California, Davis, California, 8 April 2004.

"Distortion and Densification Control during Sintering," invited seminar, Metallurgy and Materials Engineering Department, University of Nevada, Reno, Nevada, 9 April 2004.

"Net Shape Fabrication Using Advanced Powder Technologies," invited seminar, Mechanical Engineering Department, San Diego State University, San Diego, California, 15 April 2004.

"Net Shape Fabrication Using Advanced Powder Technologies," invited seminar, Materials Science and Engineering Department, University of California, Los Angeles, California, 16 April 2004.

"Introduction to Powder Metallurgy," invited undergraduate seminar, Mechanical Engineering Department, Tsinghua University, Beijing, China, 19 April 2004.

"Emerging Powder Metallurgy and Particulate Material Processes," invited graduate seminar, Mechanical Engineering Department, Tsinghua University, Beijing, China, 19 April 2004.

"Powder Injection Molding," invited seminar, State Key Laboratory for Advanced Materials, University of Science and Technology, Beijing, China, 20 April 2004.

"Powder Injection Molding," invited seminar, Materials Science and Engineering School, Huazong University of Science and Technology, Wuhan, China, 22 April 2004.

"Emerging Powder Metallurgy Processes," invited seminar, Materials Science and Engineering Department and State Key Laboratory for Powder Metallurgy, Central South University, Chengsha, Hunan, China, 24 April 2004.

"Advanced Powder Processing - Nanoscale Powders," invited seminar, Zhuzhou Cemented Carbide Tool Company, Zhuzhou, Hunan, China, 25 April 2004.

"Electrophoretic Deposition - Opportunities and Barriers in Sintered Materials," special guest speaker, Industry Member Meeting, Center for Innovative Sintered Products, Penn State Conference Center, State College, Pennsylvania, 11 May 2004.

"Research in Compaction and Sintering to the Nanoscale for Refractory Metals," invited technology seminar, H. C. Starck, Newton, Massachusetts, 25 May 2004.

"Computer Analysis and Engineering Models," invited technology seminar, H. C. Starck, Newton, Massachusetts, 25 May 2004.

"Corrosion Characteristics of Metal Powder Injection Molded (PIM) Stainless Steels," invited presentation, Heat Treatment and Corrosion Protection of Sintered Products Conference, Trinity Hotel and Conference Center, Fredericia, Denmark, 8 June 2004.

"Distortion and Densification Control During Liquid Phase Sintering of High Performance Materials," invited presentation, Eight International Conference on Numerical Methods in Industrial Forming Processes, Ohio State University, Columbus, Ohio, 14 June 2004.

"Production Cost Sensitivity Analysis for Metal Powder Injection Molding," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 14 June 2004 (with D. Blaine).

"Multiple Axis In Situ Monitoring of Polymer Burnout in Powder Compacts," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 14 June 2004 (with R. Hoseski, C. Binet, D. Blaine).

"Performance Evaluation of Sintered Tough-Coated Hard Powders (TCHPs)," presented at the Powder Metallurgy

and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 14 June 2004 (with R. E. Toth, J. McKeane, L. Smid, P. Ettmayer).

"Sinter-Brazing of Carbides to PM Sintered Steel," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 15 June 2004 (with N. S. Myers).

"Master Sintering Curve Construction Software and Its Application," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 15 June 2004 (with S. J. Park, D. Blaine, S. H. Chung).

"Analysis and Design of Press and Sinter Process for Fabrication of Precise Tungsten Carbide Cutting Tools," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 15 June 2004 (with S. H. Chung, Y. S. Kwon, M. J. Kim, C. M. Hyun).

"An Analysis of Approaches to High Performance Powder Metallurgy," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 15 June 2004 (with N. S. Myers, T. Meuller, G. Sethi, R. M. Enneti).

"Mechanical Properties of and Corrosion Resistance of PM Ni-Based Superalloys," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 16 June 2004 (with J. L. Johnson, I. M. Tan, P. Suri).

"Sintered Tolerances and the Concomitant Demands on Green Body Homogeneity," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 16 June 2004 (with L. Campbell, P. Suri, D. Blaine).

"Gravitational Effects on Distortion in Liquid Phase Sintering," presented at the Powder Metallurgy and Particulate Materials Conference PM2Tech, Metal Powder Industries Federation, Chicago, Illinois, 16 June 2004 (with N. S. H. Chung, N. Erhardt, P. Suri).

"Overview of Powder Metallurgy," invited presentation, Powder Metallurgy Basic Short Course, Metal Powder Industries Federation, Penn State Conference Center, State College, Pennsylvania, 12 July 2004.

"Metal Powder Injection Molding," invited presentation, Powder Metallurgy Basic Short Course, Metal Powder Industries Federation, Penn State Conference Center, State College, Pennsylvania, 12 July 2004.

"Computer Analysis and Engineering Sintering Models," invited presentation, Extrude Hone Corp., Irwin, Pennsylvania, 19 July 2004.

"Sintered Tolerances: Factors Related to the Green Body," invited presentation, Osram Sylvania, Towanda, Pennsylvania, 28 July 2004.

"Processing Realities, Problems, and Opportunities with Nanoscale Refractory Metals," invited presentation, Osram Sylvania, Towanda, Pennsylvania, 28 July 2004.

"Grain Boundary Wetting Transients in Liquid Phase Sintering," invited presentation, Gordon Research Conference on Solid State Studies in Ceramics, Kimball Union Academy, Meriden, New Hampshire, 9 August 2004.

"Particulate Materials Processing at the Nanoscale Size Range: Opportunities in Tungsten-Based Materials," invited presentation, Symposium Two, XIII International Materials Research Congress and VII National Congress of the Mexican Microscopy Association, Cancun, Mexico, 24 August 2004 (with E. Olevsky).

"CISP: A Critical Resource for the Microwave Powder Processing Consortia," presented at the Microwave Powder Processing Consortia Kick-Off Meeting, Materials Research Institute, Pennsylvania State University, University Park, Pennsylvania, 2 September 2004.

"Fundamentals of Sintering," invited presentation, Intermediate Powder Metallurgy Short Course, Florence, Kentucky, Metal Powder Industries Federation, 15 September 2004.

"Metal and Ceramic Injection Molding - Technical Status and Future Challenges," invited presentation, Metals and Ceramics Division, General Electric Corporate Research and Development Center, Schenectady, New York, 23 September 2004.

"Particulate Materials Processing at the Nanoscale Size Range: Opportunities in Tungsten-Based Materials," invited department seminar, Materials Science and Engineering Department, Virginia Technological Institute and State University (Virginia Tech), Blacksburg, Virginia, 1 October 2004.

"Globalization Realities: Who are the Global Competitors in Sintered Materials," invited presentation, Fall Industry Member Meeting, Center for Innovative Sintered Products, Pennsylvania State University, University Park, Pennsylvania, 5 October 2004.

"Press and Sinter Processing Realities with Nanoscale Powders," presented at the Fall Industry Member Meeting, Center for Innovative Sintered Products, Pennsylvania State University, University Park, Pennsylvania, 5 October 2004.

"Powder Injection Molding - World Markets and Technologies," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 18 October 2004 (with R. Cornwall).

"In Situ, Non-Contact Monitoring of Powder Compacts during Polymer Removal," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 18 October 2004 (with R. Loseski, C. Binet).

"Realtime Sintering Observations in W-Cu System: Accelerated Rearrangement Densification via Coated Copper Powders Approach," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 18 October 2004 (with B. Ozkal, M. L. Ovecoglu, A. Upadhyaya).

"Advances in the Sintering of Titanium," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 19 October 2004 (with D. Heaney).

"Development and Progress: Sintered Tough-Coated Hard Powders (TCHP)," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 19 October 2004 (with R. E. Toth, I. Smid, J. Leane, P. Ettmayer).

"Integral Work of Sintering Concepts Applied to Liquid Phase Sintering Densification, Distortion, and Microstructure Evolution," invited presentation PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 19 October 2004 (with D. Blaine, P. Suri, S. H. Chung, S. M. Park).

"In Situ Evaluation of Viscosity during Sintering of Boron Doped Stainless Steel using Bending Beam Technique," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 19 October 2004 (with R. Bollina).

"Supersolidus Sintering of Boron Doped Stainless Steel Powder," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 19 October 2004 (with R. Bollina).

"Green Body Homogeneity Effects on Sintered Dimensional Tolerances," presented at PM 2004 Powder Metallurgy World Congress, European Powder Metallurgy Association, Vienna, Austria, 20 October 2004.

"Mapping the Compaction and Sintering Response of Tungsten-Based Materials into the Nanoscale Size Range," presented at the International Conference on the Science of Hard Materials - 8, San Juan, Puerto Rico, 10 November 2004.

"Liquid Phase Sintering of Tough Coated Hard Particles," presented at the International Conference on the Science

of Hard Materials - 8, San Juan, Puerto Rico, 12 November 2004 (with I. Smid, L. G. Campbell, J. Lecane, R. Toth).

"Thermal Processing of Powder Injection Molded Components - Debinding and Sintering," invited presentation at the 2004 PIM Tutorial, Innovative Material Solutions, Atherton Hotel, State College, Pennsylvania, 16 November 2004.

"Design for Powder Injection Molding," invited presentation at the 2004 PIM Tutorial, Innovative Material Solutions, Atherton Hotel, State College, Pennsylvania, 16 November 2004.

"Mechanical Properties - The Mechanics-Materials Interface," invited presentation, PIM Failure Analysis Seminar, Metal Powder Industries Federation, Nittany Lion Inn, State College, Pennsylvania, 7 December 2004.

"Protocol Development for Net Shape Powder Metal Part Production Via Cold Compaction," NSF Design, Manufacturing and Industrial Innovation Conference, Scottsdale, Arizona, 4-6 January 2005 (with D. Blaine, S. J. Park, R. Engel, J. Rose, C. Binet).

"Development of Low Melting Temperature Lead-Free Solder Pastes for High Temperature Applications," The Mineral, Metals, and Materials Society 134th Annual Meeting, San Francisco, California, 15 February 2005 (with L. Campbell).

"A Model for the Consolidation of Ultrafine Refractory Metal Powders," The Mineral, Metals, and Materials Society 134th Annual Meeting, San Francisco, California, 16 February 2005.

"Bi-Material Transportation Components Using Powder Injection Molding, Densification, Shape Complexity, and Performance Attributes" The Mineral, Metals, and Materials Society 134th Annual Meeting, San Francisco, California, 16 February 2005 (with J. L. Johnson).

"Bi-Material Components Using Powder Injection Molding, Densification, Shape Complexity, and Performance Attributes," presented at the Division of Design and Manufacturing Innovation, National Science Foundation, Arlington, Virginia, 14 March 2005.

"Powder Injection Molding Tutorial," invited one day tutorial, Doubletree Mission Valley Hotel, San Diego, California, 21 March 2005.

"Unrealized Opportunities in Nanoscale Systems: PIM of W-Cu," presented at the PIM 2005 International Powder Injection Molding Conference, San Diego, California, 21 March 2005 (with E. Olevsky).

"In Situ Observation of Shape Loss and Viscosity Evolution During Polymer Burnout of Powder Metal Processing," presented at the PIM 2005 International Powder Injection Molding Conference, San Diego, California, 21 March 2005 (with R. J. Ennetti, S. V. Atre).

"Forward Projections on Dimensional Tolerances for Metal and Ceramic Powder Injection Molding," presented at the PIM 2005 International Powder Injection Molding Conference, San Diego, California, 22 March 2005 (with D. F. Heaney).

"Debinding by Wicking Large PIM Parts," presented at the PIM 2005 International Powder Injection Molding Conference, San Diego, California, 23 March 2005 (with D. C. Blaine, J. LeSalle, B. Sherman, S. Das).

"Research," invited seminar, Campus Open Forum on Research and the San Diego State University Research Foundation, San Diego State University, San Diego, California, 23 March 2005.

"Key Economic and Technical Challenges Facing the PM Industry for the Production of High PM Parts," invited keynote presentation at PMAsia 2005 Advancing PM Technology, Shanghai, China, 5 April 2005.

"Analysis of the Press and Sinter Process for Precise Production of Cemented Carbide Tools," invited presentation at PMAsia 2005 Advancing PM Technology, Shanghai, China, 6 April 2005 (with S. H. Chung, Y. Soo won, C. M.

Hyun-L. T. Lim, D. Blaine, S. J Park).

"Challenges for the Global Metal Powder Injection Molding Community," invited keynote presentation at PM Asia 2005 Advancing PM Technology, Shanghai, China, 5 April 2005.

"Thoughts and Experiences in Outreach and Services," invited presentation, Center for Advanced Vehicular Systems Extension, Mississippi State University, Canton, Mississippi, 13 April 2005.

"Bi-Material Components Using Powder Injection Molding," invited presentation, Mechanical Engineering Department, Mississippi State University, Mississippi State, Mississippi, 14 April 2005.

"Research Directions for CAVS as a Technology Center," invited presentation, Center for Advanced Vehicular Systems, Mississippi State University, Mississippi State, Mississippi, 15 April 2005.

"Realities of Nanoscale Particle Processing," invited presentation, Center for Innovative Sintered Products, Pennsylvania State University, University Park, Pennsylvania, 21 April 2005.

"Mapping the Densification and Grain Growth of Nanoscale Tungsten Carbides - Literature Review," technical seminar, Corporate Technology Center, Kennametal, Latrobe, Pennsylvania, 9 May 2005.

"Powder Injection Molding - Processes, Designs, Applications," invited one day seminar, Behrend College, Pennsylvania State University, Erie, Pennsylvania, 10 May 2005.

"Mapping the Press-Sinter Response of Metal Powders to Identify Optimized Properties," invited plenary presentation, Fourth International Conference on Powder Metallurgy, Turkish Powder Metallurgy Association, Sakarya University, Esentepe, Turkey, 18 May 2005.

"Liquid Phase Sintering of Functionally Graded W-Cu Composites," presented at the Sixteenth International Plansee Seminar, Plansee Holdings Aktiengesellschaft, Reutte, Austria, 31 May 2005 (with J.L. Johnson).

"Analysis of the Processing and Properties of Bulk Nanoscale Refractory Metals," presented at the Sixteenth International Plansee Seminar, Plansee Holdings Aktiengesellschaft, Reutte, Austria, 1 June 2005 (with D. C. Blaine, E. Olevsky).

"Critical Learning from Microgravity Sintering of Tungsten Alloys: Implications for Extraterrestrial Fabrication and Repair," presented at the Sixteenth International Plansee Seminar, Plansee Holdings Aktiengesellschaft, Reutte, Austria, 1 June 2005 (with S. J Park, J.L. Johnson).

"Research," invited one day seminar, Metal Working Products Division, Allegheny Technologies, La Verne, Tennessee, 8 June 2005.

"Verifying the Master Sintering Curve on an Industrial Furnace," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 21 June 2005 (with D. Blaine, S. J Park).

"Computer Modeling of Distortion and Densification Control During Liquid Phase Sintering of High Performance Materials," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 21 June 2005 (with D. Blaine, S. J Park).

"Metal and Ceramic Injection Molding - Technical Status and Future Challenges," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 21 June 2005.

"A Model for the Consolidation of Ultrafine Metal Powders," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 21 June 2005 (with D. Blaine, E. Olevsky).

"Critical Learning from Microgravity Sintering of Tungsten Alloys: Implications for Extraterrestrial Fabrication and Repair," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 22 June 2005 (with S. J. Park, J. L. Johnson, L. Campbell).

"CISP at Penn State - A Report on the Education, Research, and Service Program Serving the Sintered Materials Field," invited presentation, International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 21 June 2005 (with S. L. Elder).

"Bi-Material Components Using Powder Injection Molding: Densification, Shape Complexity, and Performance Attributes," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 22 June 2005.

"Cutting Edge Sintering Techniques," invited presentation, International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 22 June 2005.

"Properties and Applications of Tough Coated Hard Powders," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 23 June 2005 (with R. Toth, J. Keane, I. Smid).

"Innovative Process to Die-Compact Injection Molding Powders," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Montreal, Canada, 23 June 2005 (with R. L. Ennetti, R. Bollina, S. V. Airc).

"Overview of Powder Metallurgy," invited presentation, Basic Power Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 11 July 2005.

"Metal Powder Injection Molding," invited presentation, Basic Power Metallurgy Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 11 July 2005.

"In Situ Characterization of Apparent Viscosity for Continuum Modeling of Supersolidus Liquid Phase Sintering," presented at the Fourth International Conference on Science, Technology and Applications of Sintering, Institut National Polytechnique de Grenoble, Grenoble, France, 28 August 2005 (with D. Blaine, S. R. Bollina).

"Master Sintering Curve for a Two-Phase Material," presented at the Fourth International Conference on Science, Technology and Applications of Sintering, Institut National Polytechnique de Grenoble, Grenoble, France, 30 August 2005 (with D. C. Blaine, P. Garg).

"Modeling of Fine Molybdenum Powder for Press and Sinter Processing," presented at the Fourth International Conference on Science, Technology and Applications of Sintering, Institut National Polytechnique de Grenoble, Grenoble, France, 30 August 2005 (with D. C. Blaine, P. Garg).

"Model Materials for Liquid Phase Sintering - The Case for Tungsten Heavy Alloys," invited keynote presentation, Fourth International Conference on Science, Technology and Applications of Sintering, Institut National Polytechnique de Grenoble, Grenoble, France, 31 August 2005 (with P. Suri).

"Densification and Distortion of Liquid Phase Sintered W-Cu," presented at the Fourth International Conference on Science, Technology and Applications of Sintering, Institut National Polytechnique de Grenoble, Grenoble, France, 31 August 2005 (with J. L. Johnson).

"Pore Buoyancy and Grain Compression Contributions to Densification in Liquid Phase Sintering," presented at the Fourth International Conference on Science, Technology and Applications of Sintering, Institut National Polytechnique de Grenoble, Grenoble, France, 31 August 2005 (with J. L. Johnson).

"Liquid Phase Sintering - Agreement of Experiments and Models," invited presentation, Materials Science and Technology 2005, organized jointly by ASM-TMS-ACerS-AIST-AWS, Pittsburgh, Pennsylvania, 26 September

2005 (with J.L. Johnson, S. J Park, J.M. Martin).

"Assessment and Projections on Dimensional Capabilities of Powder Metallurgy Technologies and Needed Investments," invited presentation, Materials Science and Technology 2005, organized jointly by ASM-TMS-ACerS-AIST-AWS, Pittsburgh, Pennsylvania, 26 September 2005.

"Mapping Particle Size Distributions to Property Predictions," invited presentation, Industry Member Meeting, Center for Innovative Sintered Products, Pennsylvania State University, State College, Pennsylvania, 19 October 2005.

"Forming Metals and Ceramics Like They Were Plastics," department seminar, Mechanical Engineering Department, Mississippi State University, Mississippi State, Mississippi, 10 November 2005.

"Establishment of the Scientific Underpinnings in Powder Injection Molding and Liquid Phase Sintering," invited award lecture, Award of Distinction in Research, Autumn Meeting, Japan Society of Powder and Powder Metallurgy, Hamamatsu, Japan, 15 November 2005.

"Ceramic Injection Molding and Liquid Phase Sintering Research," invited seminar, Japan Fine Ceramic Center, Nagoya, Japan, 16 November 2005.

"Ceramic Injection Molding and Liquid Phase Sintering Research," invited seminar, National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, 17 November 2005.

"Forming Metals and Ceramics Like They Were Plastics," invited department seminar, Metallurgical and Materials Engineering Department, University of Alabama, Tuscaloosa, Alabama, 2 February 2006.

"Liquid Phase Sintering of W-Co-Mn Heavy Alloys," presented at the 2006 International Conference on Tungsten, Refractory, and Hard Metals, Metal Powder Industries Federation, Orlando, Florida, 7 February 2006 (with J.L. Johnson).

"Predictions of Tungsten Heavy Alloy Density, Size, Shape, and Microstructure in Different Gravitational Environments," presented at the 2006 International Conference on Tungsten, Refractory, and Hard Metals, Metal Powder Industries Federation, Orlando, Florida, 7 February 2006 (with S. J Park, S. H. Chung).

"Gravitational Effects on Mechanical and Microstructural Properties of tungsten Heavy Alloys" presented at the 2006 International Conference on Tungsten, Refractory, and Hard Metals, Metal Powder Industries Federation, Orlando, Florida, 8 February 2006 (with L. G. Campbell, J A. Todd).

"Model for the Press-Sinter Processing of Automotive Welding Electrodes from Refractory Metal Powders," presented at the 2006 International Conference on Tungsten, Refractory, and Hard Metals, Metal Powder Industries Federation, Orlando, Florida, 8 February 2006 (with S. J Park, L. S. Lwon).

"Plastic Injection Molding Techniques to Form Metals and Ceramics," invited seminar, Society of Plastics Engineers, Mississippi Chapter Meeting, Mississippi State University, Mississippi State, Mississippi, 14 February 2006.

"Keynote Lecture," invited presentation, Breakfast of Champions, Bagley College of Engineering, Hunter Henry Center, Mississippi State University, Mississippi State, Mississippi, 18 February 2006.

"Center for Advanced Vehicular Systems," invited presentation, Starkville Kiwanis Club, Starkville, Mississippi, 28 February 2006.

"Master Decomposition Curve for Binders in Powder Injection Molding Processing," Seventh Global Innovations Symposium: Trends in Materials R&D for Sensor Manufacturing Technologies, The Metallurgical, Metals, and Minerals Society Annual Meeting, San Antonio, Texas, 14 March 2006 (with G. Aggarwal, S. J Park, I. Smid).

"Powder Injection Molding Tutorial," invited one day short course, Metal Powder Industries Federation and Innovative Material Solutions, Wyndham Harbor Island Hotel, Tampa, Florida, 20 March 2006.

"Novel Opportunities for Lightweight Automotive Materials by Powder Injection Molding," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 21 March 2006.

"Technical and Economic Comparison of Micro Powder Injection Molding," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 21 March 2006 (with S. V. Atre, C. Wu, S. J Park, C. J Hwang, R. Zauner).

"Master Decomposition Curve for Binders in PIM Processing," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 22 March 2006 (with S. J Park, G. Aggarwal, I. Smid).

"Development of Nano-Tungsten-Copper Powder and PM Processes," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 22 March 2006 (with S. J Park, S. Lee, J U. Rho, Y. S Kwon, J L. Johnson).

"Development of Titanium Powder Injection Molding: Experiment and Simulation," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 22 March 2006 (with S. J Park, Y. Wu, G. Cai, Y. S Kwon).

"Development of Powder Injection Molding Process for Dental Scalar Tip: Mold Design and CAE Analysis," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 23 March 2006 (with S. J Park, C. J Hwang, Y. B Lo, C. T. Chung, H. P Park, S. Y. Ahn).

"Power Injection Molding of Fiber Composites and Analysis of Fiber Breakage," presented at PIM 2006, International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Tampa, Florida, 22 March 2006 (with F. Ahmad).

"CAVS," invited presentation, Dean's Development Council, Bagley College of Engineering, Mississippi State University, Mississippi State, Mississippi, 24 March 2006.

"Research Funding for Your Graduate Work," invited presentation, Graduate Student Association Fourth Annual Research Symposium, Colvard Union, Mississippi State University, Mississippi State, Mississippi, 31 March 2006.

"Forming New Ventures," invited presentation, Bagley College of Engineering Entrepreneurial Student Seminar, Mississippi State University, Mississippi State, Mississippi, 4 April 2006.

"Mapping Particle Size Distributions into Predictions of Pore Size Distributions - Implications for Optimized Properties in Sintered Materials," invited presentation, Professor Thomas Hare Retirement Seminar, Materials Science and Engineering Department, North Carolina State University, Raleigh, North Carolina, 5 April 2006.

"Bulk Materials from Nanoscale Powders," presented, U. S. Army Engineer Research and Development Center, Vicksburg, Mississippi, 19 April 2006.

"Distortion Simulation of Liquid Phase Sintering on Earth, on the Moon, on Mars and in Space," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 19 June 2006 (with S. J Park, S. H. Chung, J L. Johnson)

"Rheological Underpinnings to Powder Injection Molding and Liquid Phase Sintering," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 19 June 2006.

"Microstructural Evolution of Tungsten Heavy Alloys During Heating to the Sintering Temperature," presented at

the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 19 June 2006 (with J.M. Martin, J.L. Johnson, F. Castro)

"Development of Nano-Tungsten-Copper Powder and PM Process," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 19 June 2006 (with S. J. Park, S. Lee, J.U. Roh, Y. S. Kwon, S. T. Chung, J.L. Johnson).

"Innovations in Sintering: New Processes for Challenging Materials," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 20 June 2006.

"Preparation of Metal Composite Mixes for Powder Injection Molding," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 20 June 2006 (with F. Ahmad).

"Special Sintering Technologies for Nanostructured Tungsten Carbide," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 20 June 2006 (with S. J. Park, J.L. Johnson).

"Grain Size Measurement and Modeling for Nanostructured Tungsten Carbide," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 21 June 2006 (with S. J. Park, A. Cowan, J.L. Johnson).

"Master Decomposition Curve for Binders in Die Compaction Processing," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 21 June 2006 (with S. V. Atre, S. J. Park, R. Enneti).

"Full Density Via Dynamic Compaction," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 21 June 2006 (with G. Sethi, N. Myers).

"Detailed Linkages of Powder Characteristics to Properties in Press-Sinter Processing of Powder Metals," presented at the International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 21 June 2006.

"Research Issues in Automotive Materials for Reduced Weight, Improved Efficiency, and Crashworthiness," invited presentation, Catedra Randall German en Pulvimetalurgia, Universidad Internacional Menendez y Pelayo, Palacio de la Magdelena, Santander, Spain, 13 July 2006.

"Detailed Linkages of Powder Characteristics to Properties in Press-Sinter Processing of Powder Metals," invited seminar, Catedra Randall German en Pulvimetalurgia, Universidad Internacional Menendez y Pelayo, Palacio de la Magdelena, Santander, Spain, 14 July 2006.

"The Status of PM and PIM in the USA," invited presentation, Primer Congreso Espanol de Pulvimetalurgia (First Spanish Powder Metallurgy Congress), Universidad Carlos III de Madrid, Leganes, Madrid, Spain, 18 July 2006.

"Tutorial on Electrical Contacts Fabricated by Powder Metallurgy," invited seminar, Cummins Power Generation, Findley, Minnesota, 20 July 2006.

"Overview of Powder Metallurgy," invited seminar, Basic Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 31 July 2006.

"Metal Powder Injection Molding," invited seminar, Basic Short Course, Metal Powder Industries Federation, State College, Pennsylvania, 31 July 2006.

"Particulate Materials Processing at the Nanoscale Range: Opportunities in Tungsten-Based Composites," technical

seminar, Materials Division, Army Research Laboratory, Aberdeen Proving Grounds, Maryland, 2 August 2006.

"Welcome and Overview of the Center for Advanced Vehicular Systems," presented to Powder Metallurgy Program, US Advanced Materials Program for US Car, Starkville, Mississippi, 8 August 2006.

"R&D Strategy for Tungsten Powders," presented to ATI Metalworking Products, Huntsville, Alabama, 9 August 2006.

"Center for Advanced Vehicular Systems," presented at the Bagley College of Engineering Department Heads and Center Directors Retreat, Columbus, Mississippi, 11 August 2006.

"Center for Advanced Vehicular Systems," presented to the Greater Starkville Development Partnership, Starkville, Mississippi, 7 September 2006.

"Powder Injection Molding Research at CAVS, Targeting Metal and Ceramic Molding Using Plastic Technology," keynote presentation, Industrial Tooling 2006, Center for Manufacturing Technology Excellence, East Mississippi Community College, Mayhew, Mississippi, 21 September 2006.

"Technical and Economical Comparison of Micro Powder Injection Molding," presented at the 2006 Powder Metallurgy World Congress, Busan, Korea, 25 September 2006 (with S. J Park, S. Atre, C. Wu, R. Zauner).

"Various Master Sintering Curve Concepts and Its Applications," presented at the 2006 Powder Metallurgy World Congress, Busan, Korea, 25 September 2006 (with S. J Park, D. Blaine).

"Design Regression for Identification of Optimal Components for Metal Powder Injection Molding," invited presentation, 2006 Powder Metallurgy World Congress, Busan, Korea, 25 September 2006.

"Unified Molding and Simulation for Nanostructured Tungsten Carbide," presented at the 2006 Powder Metallurgy World Congress, Busan, Korea, 26 September 2006 (with S. J Park, J L. Johnson).

"Development of Nano Tungsten-Copper Powder and PM Process," presented at the 2006 Powder Metallurgy World Congress, Busan, Korea, 26 September 2006 (with S. Lee, J W. Noh, Y. S. won, S. T. Chung, J L. Johnson, S. J Park).

"Mapping Particle Size Distributions into Predictions of Properties for Powder Metal Compacts," presented at the 2006 Powder Metallurgy World Congress, Busan, Korea, 27 September 2006.

"Development of Titanium Powder Injection Molding, Experiment and Simulation," presented at the 2006 Powder Metallurgy World Congress, Busan, Korea, 27 September 2006 (with S. J Park, Y. Wu, G. Gai, X. Zhu, and S. S. won).

"The General Trend of the Powder Metallurgy Field in the USA," invited seminar, Department of Materials Science and Engineering, Gyungsang National University, Jinju, Korea, 29 September 2006.

"Graduate Study in the USA and Research at Mississippi State University," invited seminar, College of Engineering, Hoseo Chai University, Daejeon, Korea, 2 October 2006.

"Liquid Phase Sintering Models with Gravitational Effects," invited seminar, Department of Materials Science, Korea Advanced Institute of Science and Technology, Deajeon, Korea, 2 October 2006.

"Entrepreneurial Perspectives for University-Based Companies," invited seminar, Daedeok Innopolis, Daejeon Special Research and Development Region, Daejeon, Korea, 2 October 2006.

"Research Opportunities in Nanoscale Tungsten," invited seminar, Agency for Defense Development, Daejeon, Korea, 2 October 2006.

"Automotive Research and Market Trends in the USA," invited seminar, Department of Mechanical Engineering, Kyushu National University, Fukuoka, Japan, 4 October 2006.

"Tungsten Heavy Alloys as a Basis for Modeling Deformation in Particulate Composites," presented at the Deformation Mechanisms in Complex Materials Symposium, 2006 Materials Science and Technology Conference, Cincinnati, Ohio, 16 October 2006 (with R. Yassar, S. J Park).

"Dimensional Control Issues in Field Repair Environments Including Extraterrestrial Fabrication and Repair," invited presentation, Materials Processing Challenges for the Aerospace Industry: PM Processing, Metals, 2006 Materials Science and Technology Conference, Cincinnati, Ohio, 17 October 2006 (with S. J Park).

"Model for the Press-Sinter Processing of Ultrafine and Nanoscale Tungsten, Tungsten-Copper, and Tungsten Carbide - Cobalt," presented at the Nanomaterials Science and Technology Symposium, 2006 Materials Science and Technology Conference, Cincinnati, Ohio, 19 October 2006 (with S. J Park, J L. Johnson).

"Atomistic Simulation in Powder Metallurgy," presented at the Role of Computational Methods in Materials Research and Development Symposium, 2006 Materials Science and Technology Conference, Cincinnati, Ohio, 19 October 2006 (with S Lim, S. G Lim, S. J Park).

"Injection Molding of Metals and Ceramics Via Polymer Binders," invited departmental seminar, Department of Chemistry, Mississippi State University, 2 November 2006.

"Pore Size Distributions in Particulate Materials Processing," invited departmental seminar, Mechanical Engineering Department, University of California, San Diego, California, 20 November 2006.

"Microstructures and Mechanical Behavior of Biological Composite Materials for Armor Design Applications," Symposium DD, Mechanics of Biological and Bio-Inspired Materials, Materials Research Society, Boston, Massachusetts, 28 November 2006 (with H. Rhee, Y. Hwang, S. H. Elder).

"Powder Injection Molding Research and Development," invited presentation, 2007 International Conference on Powder Injection Molding, Metal Powder Industries Federation, Lake Buena Vista, Florida, 22 February 2007.

"University Spin-Off Companies: The Need for Rational Matches of the Inside and Outside Environments," invited presentation, Intellectual Property in Materials Science: Patents, Tech Transfer and Licensing Symposium, 136th Annual Meeting, The Minerals, Metals, and Materials Society, Orlando, Florida, 26 February 2007.

"Linkages Between Atomistic and Continuum-Based Simulations in Nanoscale Powder Metallurgy," presented at the Advances in Computational Materials Science and Engineering Methods Symposium, 136th Annual Meeting, The Minerals, Metals, and Materials Society, Orlando, Florida, 27 February 2007 (with S. G Lim, S Lim, S. J Park).

"Innovations in Sintering - New Processes for Challenging Materials," invited keynote presentation, PM Asia 2007 International Conference, Elsevier Metal Powder Report, Shanghai, China, 3 April 2007.

"Development and Potential of Titanium Powder Injection Moulding," invited keynote presentation, Metal Injection Moulding Workshop, PM Asia 2007 International Conference, Elsevier Metal Powder Report, Shanghai, China, 3 April 2007.

"Powder Injection Molded Ceramic Microsystems," presented at the Third International Conference on Interconnection and Ceramic Microsystems Technologies, International Microelectronics and Packaging Society, Denver, Colorado, 23 April 2007 (with C. Wu, S. V. Atre, D. Whychell, S. J Park).

"Nanoscale SiC Sintered Structures for Advanced Microsystems and Power Electronics Packaging," presented at the Third International Conference on Interconnection and Ceramic Microsystems Technologies, International Microelectronics and Packaging Society, Denver, Colorado, 24 April 2007 (with M. Bothara, S. V. Atre, S. J Park, T. S. Sudarshan, R. Radhakrishnan, O. Ostroverkhova).

"Master Sintering Curve Analysis of Liquid Phase Sintered, Nanoscale Silicon Carbide Fabricated in a Plasma Pressure Compaction System," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 14 May 2007 (with S. V. Atre, M. Botham, S. J Park, P. Sudershan, P Radhakrisnan).

"Novel Methodology to Quantify Tool Wear in Powder Metallurgy," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 14 May 2007 (with J. L. Thompson, S. J Park, F. Findik, A. Antonyraj).

"Binder Optimization for the Production of Tungsten Feedstock in PM," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 14 May 2007 (with T. Piotr, J. J Oakes).

"Effect of Particle Shape and Fiber Length on Viscosity of Metal Composite Mixes," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 14 May 2007 (with F. Ahmad).

"Development of the High Performance W-Cu Electrode," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 15 May 2007 (with Y. S. Kwon, S. T. Chung, S. Lee, J W. Noh, S. J Park).

"Simulation of Binder-Powder Separation in Powder Injection Molding," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 15 May 2007 (with S. H. im, S. J Park, S. V. Atre).

"Linking Homogenization and Densification in Tungsten Heavy Alloys," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 15 May 2007 (with S. J Park, G. Sethi, J L. Johnson).

"Powder Infused Fatty Materials and Their Possible Applications," presented at Weird PM: Next Generation Materials, Processes and Applications, 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 15 May 2007 (with T. L. Piotr, A. Antonyraj, M. T. Tucker, J J Oakes, S. J Caldwell)

"Mechanical and Physical Properties of Novel Titanium and Silicon Carbide Mixed Powder Sintered Aluminum," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007 (with F. Findik, J. L. Thompson, A. Antonyraj, S. J Park).

"Atomistic Simulation of Activated Sintering of Tungsten by Additives," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007 (with S. G. H im, A. Moitra, S. H Lim, S. J Park).

"Thermal Expansion and Viscoelastic Properties of Sintered Porous Ferrous Components," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007 (with A. Antonyraj, S. J Park).

"Gravitational Effects on Microstructures in Liquid Phase Sintering," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007 (with L. G. Campbell).

"Gravitational Effects on Hardness in Liquid Phase Sintering," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007 (with L. G. Campbell).

"Self-Similar Aspects of Particulate Materials Processing," presented at 2007 International Conference on Powder

Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007.

"Numerical Investigations of Mixing for Powder Injection Molding Feedstock," presented at 2007 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Denver, Colorado, 16 May 2007 (with S. J Park, S. Y. Ahn, T. G Lang, S. V. Atre).

"Densification and Grain Growth During the Sintering of Nanoscale SiC," presented at the 2007 NSTI Nano Technology Conference, Nano Science and Technology Institute, Santa Clara, California, 20 May 2007 (with M. Bothara, S. V. Atre, S. J Park, T. S. Sudarshan, R. Radhakrishnan).

"Overview of Powder Metallurgy," presentation to National Science Foundation Teachers Conference, Mississippi State, University, Starkville, MS, 26 June 2007.

"Continuous Distributions in Powder Processing - Models, Origins, and Applications in Atomization, Packing, Sintering, Polymer Pyrolysis, and Fiber Fracture," department seminar, Departamento de Ciencia e Ingeniería de Materiales e Ingeniería Química, Universidad Carlos III de Madrid, Leganes, Spain, 11 July 2007.

"Mechanical and Physical Properties of Sintered Aluminum Mixed Powder Systems," invited seminar, Materiales Estructurales para las Nuevas Technologias, Verano Program, Universidad Carlos III de Madrid, Colmenarejo, Spain, 12 July 2007.

"Overview of Powder Metallurgy," invited seminar, Powder Metallurgy Basic Short Course, Penn State University, Metal Powder Industries Federation, 16 July 2007.

"Metal Powder Injection Molding," invited seminar, Powder Metallurgy Basic Short Course, Penn State University, Metal Powder Industries Federation, 16 July 2007.

"The Tungsten and Tungsten Carbide Short Course," invited short course, Allegheny Technologies, Metalworking Products, Huntsville, Alabama, 14 August 2007.

"Powder Metallurgy and Particulate Materials," invited short course, Thin Films Division, Heraeus, Chandler, Arizona, 27 August 2007.

"Sintering Concepts and Their Applications in Particulate Materials Processing," invited presentation, Austrian Research Centers, Seibersdorf, Austria, 19 September 2007.

"Scientific Realities in High Density Ferrous Powder Metallurgy," invited presentation, MIBA Sintermetall, Vorchdorf, Austria, 20 September 2007.

"Overview of the Center for Advanced Vehicular Systems," presented to Powder Technology Center, Austrian Research Centers, Seibersdorf, Austria, 21 September 2007.

"An Inverse Approach to Selection of Component Designs for Metal Powder Injection Molding," invited presentation, PM 2007 European Powder Metallurgy Association Conference, Toulouse, France, 17 October 2007.

"Transient Liquid Phase Sintering," invited presentation, Cookson Electronics Semiconductor Products, Suwanee, Georgia, 5 November 2007.

"Metal Powder Injection Molding," invited presentation, Drivetrain Division - GKN, Auburn Hills, Michigan, 14 November 2007.

"Modeling of Materials Processes - The Difficult Problems with Particulates," Invited Keynote presentation, 50th Jubilee Celebration, International Conference on Advanced Manufacturing Technologies ICAMT - 2007, Durgapur, West Bengal, India, 29 November 2007 (with S. J Park).

"Powder Injection Molding of Metals, Ceramics, and Carbides," invited presentation, Mueller Industries, Fulton,

Mississippi, 7 February 2008.

"Management Issues in Interdisciplinary Engineering Research," invited presentation, College of Engineering, San Diego State University, San Diego, California, 6 March 2008.

"Integral Work-Concepts in Materials Processing: Efficient Routes to Computer Simulations," invited presentation, Department of Mechanical Engineering, San Diego State University, San Diego, California, 7 March 2008.

"The Effect of Binder System on Mold Filling in Ceramic Micro Powder Injection Molding," presented at PM 2008 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Metal Powder Industries Federation, Long Beach, California, 11 March 2008 (with C. Wu, L. Simmons, S. Laddha, S. Lee, S. J Park, S. V. Atre).

"Characterizing Material Homogeneity in Ceramic Microarrays Fabricated by Powder Injection Molding," presented at PM 2008 International Conference on Powder Injection Molding of Metals, Ceramics, and Carbides, Metal Powder Industries Federation, Long Beach, California, 11 March 2008 (with C. Wu, L. Simmons, S. Laddha, S. Lee, D. T. Whychell, S. J Park, S. V. Atre).

"Microstructure and Mechanical Properties of Sintered Ti-Fe-Zr," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 9 June 2008 (with O. Gulsoy, P. Suri, S. J Park, A. Arockasamy, H. El-Ladiri, R. Whitehorn).

"Development of Nanotubes Reinforced Metal Composites for Heat Sinking Applications," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 9 June 2008 (with F. Ahmad, M. Norani, G. Gehad).

"Development of Carbon Nanotube-Reinforced Copper," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 9 June 2008 (with Y. S. Kwon, S. T. Chung, S. Lee, J W. Noh)

"A Technical and Market Contrast and Comparison for Metal Powder Injection Molding," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 9 June 2008.

"Mapping between Material Design and Properties Using Material Informatics for PM Simulation," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 10 June 2008 (with S. J Park, S. Lee, S. V. Atre).

"Integrated Simulation of Mold Filling (Binder-Powder Separation), Debinding, and Sintering in Powder Injection Molding," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 10 June 2008 (with S. J Park, S. Lim, S. V. Atre).

"Prediction of Tool Wear and Tool Life by Experiment, Modeling, and Simulation of the Die Compaction Process," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 10 June 2008 (with W. Li, S. J Park, Y. Hammi, P. J Blau).

"Effect of Powder Characteristics and Sintering Conditions on Density and Corrosion Resistance of MIM 316L," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 10 June 2008 (with R. L. Dwivdi, D. F. Heaney).

"Development and Analysis of Bio-Inspired Design Aluminum Composites," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 11 June 2008 (with A. Arockasamy, P. Suri, S. J Park).

"Mixing Simulation for Powder Injection Molding Feedstock: Quantification and Sensitivity Analysis," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 11 June 2008 (with S. Ahn, T. Gallang, S. J Park, S. V. Atre).

"The Effect of Feedstock Composition on Defect Evolution in Powder Injection Molded Ceramic Microarrays," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 11 June 2008 (with S. V. Atre, S. Ladha, C. Wu, J. Simmons, S. J Park).

"EDM Performance of W-Cu Electrodes by Nano Tungsten," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 12 June 2008 (with Y. S. won, S. T. Chung, J H. Lee, M. S. Jun, S. Lee, J W. Noh).

"Fracture and Fragmentation Problems in Particulate Materials Processing," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 12 June 2008.

"Densification Behavior and properties of Spark Plasma Sintered HfB2-20SiC," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 12 June 2008 (with S. V. Atre, G. L endoll, M. Othara, H. Shoop, C. Carney, S. J Park).

"Injection Molding of Micro-Porous 316L Stainless Steel Parts," presented at the 2008 World Congress on Powder Metallurgy and Particulate Materials, Washington, District of Columbia, 11 June 2008 (with O. Gulsoy, P Suri, S. J Park).

"High Rate Deformation in Press-Sinter W-Cu Using Hopkinson Bar Test," presented at the International Conference on Tungsten, Refractory and Hardmaterials VII, Washington, District of Columbia, 11 June 2008 (with M. Tucker, D. L. Bammann, S. J Park, Y. S. won).

"Three Dimensional Atomistic Simulation of the Sintering and Shrinkage Behavior of Nanoscale Tungsten," presented at the International Conference on Tungsten, Refractory and Hardmaterials VII, Washington, District of Columbia, 11 June 2008 (with A. Moitra, S. im. S-G. im, S. J Park).

"Overview of Powder Metallurgy," invited presentation, 2008 Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Penn Stater Hotel, State College, Pennsylvania, 21 July 2008.

"Metal Powder Injection Molding," invited presentation, 2008 Basic Powder Metallurgy Short Course, Metal Powder Industries Federation, Penn Stater Hotel, State College, Pennsylvania, 21 July 2008.

"Development of Novel Bio-Inspired Design Ferrous Components," presented at the 2008 Bio-Inspired Design Conference, Mississippi State University, Starkville, Mississippi, 22 August 2008 (with A. Arockiasamy, P Suri, S. J Park, G. Thibaudeau, B. Baldwin, L. Cho).

"Light Metals Research and Barriers for Automotive Applications," invited conference keynote lecture, Fifth International Powder Metallurgy Conference, Turkish Powder Metallurgy Association, TOBB ETU, Ankara, Turkey, 9 October 2008.

"Investigation of Sintering Behavior and Mechanical Properties of Al HM Alloys by the Addition of Cu and Mg," presented at the Fifth International Powder Metallurgy Conference, Turkish Powder Metallurgy Association, TOBB ETU, Ankara, Turkey, 10 October 2008 (with E. Findik, A. Antonyraj, S. J Park).

"Atomistic Scale Study on Effect of Crystalline Misalignment on Densification during Sintering Nano Scale Tungsten Powder," presented at the International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 17 November 2008 (with A. Moitra, S. im, S. G. im, S. J Park).

"Gravitational Role in Liquid Phase Sintering," presented at the International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 18 November 2008 (with S. J Park, P Suri, J L. Johnson, I. G. Campbell).

"Coarsening Laws in Sintering," invited presentation, International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 19 November 2008.

"Linearization of Master Sintering Curves, invited presentation, International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 20 November 2008 (with D. C. Blaine, S. J Park).

"Master Sintering Curve Formulated from Constitutive Models," presented at the International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 20 November 2008 (with S. J Park, F Suri, E. Olevsky).

"Effect of Volume Fraction on Grain Growth during Liquid Phase Sintering of Tungsten Heavy Alloys," presented at the International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 21 November 2008 (with J L. Johnson, L. G. Campbell, S. J Park).

"Microstructure Relations and Input Knowledge Required in Liquid Phase Sintering," presented at the International Conference on Sintering 2008, American Ceramic Society, La Jolla, California, 21 November 2008.

"Innovations in Sintered Materials for Demanding Applications," invited keynote presentation, 2009 International Conference on the Frontiers of Metallurgy and Materials Technology, Taramati Baradari Conference Center, Mahatma Gandhi Institute of Technology, Hyderabad, India, 30 January 2009.

"Designing at the Particle Level," invited presentation, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad, India, 30 January 2009.

"Development of Powder Injection Molding Process for Sponge Ti Alloy," presented at the Symposium on Powders, Composites, Coatings and Measurements, The Minerals, Metals, and Materials Society, Annual Meeting, San Francisco, 19 February 2009 (with O. Gulsoy, F Suri, S. J Park, A. Antonyraj, F Wang).

"Sintering Response of Aluminum Alloys With and Without Addition of Si and SiC by Powder Metallurgy," presented at the Symposium on Aluminum Alloys Fabrication, Characterization and Applications, The Minerals, Metals, and Materials Society, Annual Meeting, San Francisco, 19 February 2009 (with A. Arockiasamy, S. J Park, F Wang).

"Powder Injection Molding Tutorial – Metal, Ceramic, and Carbide Molding," invited one day short course, Metal Powder Industries Federation, Orlando, Florida, 2 March 2009.

"Development of Copper Distributor by Powder Injection Molding," presented at the 2009 Conference on Powder Injection Molding, Metal Powder Industries Federation, Orlando, Florida, 4 March 2009 (with S. T. Chung, Y. S. Kwon, S. J Park).

"Development of PIM for Sponge Titanium," presented at the 2009 Conference on Powder Injection Molding, Metal Powder Industries Federation, Orlando, Florida, 4 March 2009 (with O. Gulsoy, F Suri, A. Antonyraj, S. J Park, F Wang).

"Effect of Powders and Binders on Rheological Behavior and Molding Parameters in Powder Injection Molding Process," presented at the 2009 Conference on Powder Injection Molding, Metal Powder Industries Federation, Orlando, Florida, 3 March 2009 (with S. Ahn, S. Lee, S. J Park, S. V. Atre).

"An Assessment of the Technical and Marketing Barriers," invited presentation, Workshop for Scientific Issues on Medical Applications of Micro/Nano Powder Injection Molding – Molding, Sintering, Modeling, and Commercial Applications, National Science Foundation and Korea-US Science Cooperation Center, Orlando, Florida, 5 March 2009.

"Granularity Issues in Computer Simulations Supporting Micro PIM," invited presentation, Workshop for Scientific Issues on Medical Applications of Micro/Nano Powder Injection Molding – Molding, Sintering, Modeling, and Commercial Applications, National Science Foundation and Korea-US Science Cooperation Center, Orlando, Florida, 5 March 2009 (with S. J Park, S. Ahn, T. Gerlang, S. T. Chung, S. Gerlim, S. Atre).

"Atomistic Simulations of Nanoparticle Sintering," invited presentation, Workshop for Scientific Issues on Medical Applications of Micro/Nano Powder Injection Molding – Molding, Sintering, Modeling, and Commercial Applications, National Science Foundation and Korea-US Science Cooperation Center, Orlando, Florida, 5 March 2009 (with Seong-Gon Kim, Amitava Moitra, Sunghoon Lim, Seong-Jin Park).

"Material Homogeneity in Ceramic Microarrays," invited presentation, Workshop for Scientific Issues on Medical Applications of Micro/Nano Powder Injection Molding – Molding, Sintering, Modeling, and Commercial Applications, National Science Foundation and Korea-US Science Cooperation Center, Orlando, Florida, 4 March 2009 (with Sundar V. Atre, Sachin Laddha, Carl Wu, Shiwoo Lee, Levin Simmons, Seong-Jin Park).

"Mixing of Nanoscale Powders and Polymers for Micro-Powder Injection Molding," invited presentation, Workshop for Scientific Issues on Medical Applications of Micro/Nano Powder Injection Molding – Molding, Sintering, Modeling, and Commercial Applications, National Science Foundation and Korea-US Science Cooperation Center, Orlando, Florida, 4 March 2009 (with Tae Gon Kang, Seokyoung Ahn, Sundar V. Atre, Seong-Jin Park).

"Powder Metallurgy for Automotive Applications in the Overall Context of Materials Research and Market Forces," plenary presentation, PM Asia 09, Elsevier Scientific, Shanghai, China, 6 April 2009.

"Trends in Powder Injection Molding: Designs- Materials-Applications," invited presentation, Tongji University, Shanghai, China, 7 April 2009.

"The Emerging Market for Microminiature Powder Injection Molding Medical Components and the Required Technology for Participation," keynote presentation, PM Asia 09, Elsevier Scientific, Shanghai, China, 7 April 2009.

"Characterization of Injection Moldability of Hydride-Dehydride Titanium Powder," presented at PM Asia 09, Elsevier Scientific, Shanghai, China, 7 April 2009 (with Y. Wu, S. J Park, D. F. Heaney, G. Gai).

"Management of Product Qualification Cycles," invited presentation, Hanaea Ventures Business Advisory Board Meeting, Vancouver, British Columbia, Canada, 19 May 2009.

"Development of Thermal Management Material: Nano Tungsten Coated Copper and Carbon Nanotube Reinforced Copper," presented at the Seventeenth Plansee Seminar, Plansee Group, Reutte, Austria, 25 May 2009 (with Y. S. Kwon, S. T. Chung, S. Lee, S. J Park).

"Grain Size Evolution and Grain Size Distribution in Sintered Materials," invited plenary presentation at the *Seventeenth Plansee Seminar*, Plansee Group, Reutte, Austria, 26 May 2009.

"Atomistic Scale Study on Sintering of Nanoscale Tungsten Powder," poster presentation, presented at the *Seventeenth Plansee Seminar*, Plansee Group, Reutte, Austria, 26 May 2009 (with A. Moitra, S. Kim, S. G. Kim, S. J Park).

"A Quantitative Model for the Effects of Gravity on the Mechanical Behavior of Tungsten Heavy Alloys," poster presentation, presented at the *Seventeenth Plansee Seminar*, Plansee Group, Reutte, Austria, 27 May 2009 (with I. G. Campbell, J. L. Johnson).

"Bio-Inspired Design – Significant Challenges to Powder Metallurgy," invited presentation, 2009 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, American Powder Metallurgy Institute, Las Vegas, Nevada, 30 June 2009 (with Giselle Thibaudeau).

"Injection Molded Titanium -- Combined Technology and Economic Needs to Penetrate High Volume Applications, invited presentation, 2009 International Conference on Powder Metallurgy and Particulate Materials, MPIF, Las Vegas, Nevada, 1 July 2009.

"Overview of Powder Metallurgy," invited presentation, Basic Powder Metallurgy Short Course, Penn State

University, Penn Stater Hotel, State College, Pennsylvania, organized by Metal Powder Industries Federation, Princeton, New Jersey, 27 July 2009.

"Metal Powder Injection Molding," invited presentation, Basic Powder Metallurgy Short Course, Penn State University, Penn Stater Hotel, State College, Pennsylvania, organized by Metal Powder Industries Federation, Princeton, New Jersey, 27 July 2009.

"Metal Powder Injection Molding," invited seminar, Materials Science and Engineering, University College Dublin, Dublin, Ireland, 11 August 2009.

"Powder Injection Molding - State of the Art," invited seminar, Health and Environmental Department, Austrian Institute of Technology, Wr. Neustadt, Austria, 1 September 2009.

"PIM State of the Art," invited seminar, Powder Technology Division, Austrian Institute of Technology, Seibersdorf, Austria, 2 September 2009.

"Ceramic Powder Injection Molding," two day short course, Double Tree Hotel, San Diego, California, organized by the American Ceramic Society, Westerville, Ohio, 16-17 September 2009.

"Introduction to Metal Powder Injection Molding," invited seminar, Ophthalmic Systems, Becton Dickinson, Waltham, Massachusetts, 15 October 2009.

"Powder Injection Molding of Titanium Medical Devices and Implants," invited seminar, Mechanical Engineering Department, University of California Riverside, Riverside, California, 19 February 2010.

"Powder Injection Molding Tutorial: Metals, Ceramics, and Carbides," invited one day seminar, Metal Powder Industries Federation, Long Beach, California, 28 March 2010.

"Powder Injection Molding of Various Titanium Compositions," contributed presentation, MIM2010, Metal Powder Injection Molding Conference, Metal Powder Industries Federation, Long Beach, California, 29 March 2010.

"Effect of Additives on Sintering Response of Titanium by Powder Injection Molding," contributed presentation, MIM2010, Metal Powder Injection Molding Conference, Metal Powder Industries Federation, Long Beach, California, 29 March 2010 (with A. Arockiasamy and S. J Park).

"Current Issues in Powder Injection Molding as Seen Via the Emerging Market for Microminiature Medical Components," invited presentation, Hanyang University, Ansan, Korea, 6 April 2010.

"Metal Powder Injection Molding and the Combined Technology and Economic Situation Needed to Penetrate High Volume Applications," Invited Plenary Lecture, Spring Meeting of Korean Powder Metallurgy Institute, Andong University, Andong, Korea, 9 April 2010.

"Thermal Materials by Metal Powder Injection Molding," invited seminar, Mechanical Engineering Department, Pohang University of Science and Technology, Pohang, Korea, 12 April 2010.

"Trends in Powder Metallurgy and Metal Powder Injection Molding," invited seminar, Korean Institute of Materials Science, Gyeongnam, Korea, 13 April 2010.

"Trends in Metal Injection Molding," invited seminar, Yuelong Superfine Metal Material, Dayu, China, 15 April 2010.

"Microstructure Retention and the Reality of Grain Coarsening during Sintering," invited presentation, Advanced in Nanoparticle Science and Technology Program, Powder Met 2010, Fort Lauderdale, Florida, 28 June 2010.

"Effect of Sintering Environments on Corrosion of Powder Injection Molded 316L Stainless Steel Parts," contributed presentation, Powder Met 2010, Metal Powder Industries Federation, Fort Lauderdale, Florida, 29 June

2010 (with F. Ahmad, M. R. Raza, and M. A. Omar).

"Conceptual Optimization of Titanium Metal Powder Injection Molding," contributed contribution, Powder Met 2010, Metal Powder Industries Federation, Fort Lauderdale, Florida, 29 June 2010.

"Influence of Powder Preparation on Consolidation Behavior and Properties of Tungsten-Copper Alloys," contributed contribution, Powder Met 2010, Metal Powder Industries Federation, Fort Lauderdale, Florida, 30 June 2010 (with W. Li, W. M. Rashad, A. Bothale, Z. Abdel-Hamid, R. Yamanoglu, S. Moustafa, and E. A. Olevsky).

"Overview of Powder Metallurgy," invited presentation, Basic Powder Metallurgy Short Course, Penn State University, Penn Stater Hotel, State College, Pennsylvania, organized by Metal Powder Industries Federation, Princeton, New Jersey, 26 July 2010.

"Shape and Size Factors in Conventional SPS and Free Pressureless SPS," invited presentation, Materials Science and Engineering 2010, Darmstadt, Germany, 23 August 2010 (E. Olevsky, C. Garcia, E. Maleghi, W. Bradbury, W. Li)

"Introduction to Metal Powder Injection Molding," invited presentation, Basic Powder Metallurgy Short Course, Penn State University, Penn Stater Hotel, State College, Pennsylvania, organized by Metal Powder Industries Federation, Princeton, New Jersey, 26 July 2010.

"Coarsening during Sintering," contributed presentation World Congress PM 2010, European Powder Metallurgy Association, Florence, Italy, 11 October 2010.

"Markets and Technology for Titanium Metal Powder Injection Moulding," contributed presentation World Congress PM 2010, European Powder Metallurgy Association, Florence, Italy, 12 October 2010.

"Thermal Management Applications for Nano Tungsten Copper Composite Powder," contributed presentation World Congress PM 2010, European Powder Metallurgy Association, Florence, Italy, 13 October 2010 (with S. J. Park, Y. S. Kwon, S. Lee, J. L. Johnson).

"Press-Sinter Simulation Tool and Its Applications," contributed presentation World Congress PM 2010, European Powder Metallurgy Association, Florence, Italy, 12 October 2010 (with S. J. Park, S.-T. Chung, Y.-S. Kwon).

"Simulation Tool for Powder Injection Molding and Its Applications," contributed presentation World Congress PM 2010, European Powder Metallurgy Association, Florence, Italy, 12 October 2010 (with S.-T. Chung, S. Ahn, S. J. Park).

"Coupled Electro-Thermo-Mechanical Analysis of Conventional SPS and Free Pressureless SPS," presented at the 2010 Materials Science and Technology Conference, ASM International-American Ceramic Society-Metallurgical Society, Houston, Texas, 19 October 2010 (with E. Olevsky, C. Garcia, E. Maleghi, W. Bradbury)

"Sintering: Atomistic," and "Sintering Tools," invited seminars, Diamond Research Laboratory, Element Six, Springs, South Africa, 25 and 26 October 2010.

"Coarsening during Sintering," keynote presentation, South African Powder Metallurgy Association, DeBeers Technology Center, Johannesburg, South Africa, 27 October 2010.

"Strength Evolution in Sintering," invited presentation, South African Powder Metallurgy Association, DeBeers Technology Center, Johannesburg, South Africa, 27 October 2010.

"Liquid Phase Sintering," and "Sintering Densification" invited seminars, Diamond Research Laboratory, Element Six, Springs, South Africa, 28 and 29 October 2010.

"Effect of Rheological Behavior in Powder Injection Molding Process," invited presentation, 2010 Fall Conference of Korean Society of Rheology, Daejon, South Korea, 19 November 2010 (with S. J. Park and S. Ahn).

"Process Development and Modeling for Thermal Management: Nano-W-Coated-Cu and CNT-Reinforced-Cu," 12th Cross Straits Symposium on Materials, Energy and Environmental Engineering (CSS 12), Pohang, Korea, 17 November 2010 [Outstanding Paper Award] (with J.M. Park, D.-Y. Park, S. J. Park, S. Lee, Y.-S. Kwon, S.-T. Chung).

"Powder Injection Molding," invited seminar, Corporate Technology Center, Kennametal Incorporated, Latrobe, Pennsylvania, 18 February 2011.

"Progress and Potential of Free Pressureless Spark Plasma Sintering (FPSPS) Processing," contributed presentation, 2011 Symposium on Functional and Structural Nanomaterials: Fabrication, Properties, Applications and Implications: San Diego, California, 28 February 2011 (W. Bradbury, R. Yamanoglu, W. Li, E. Olevsky).

"Coarsening Models Applicable to Sintering," invited keynote presentation, 2011 Annual Meeting, The Minerals, Metals, and Materials Society, San Diego, California, 1 March 2011.

"Determination of the Spark Plasma Sintering Fundamental Densification Mechanisms by Novel Cyclic Loading Approach," contributed presentation, Symposium Materials Processing Fundamentals: Powders and Composites, San Diego, California, 2 March 2011 (W. Li, W. Bradbury, J.M. Lattrick, E. Olevsky).

"Fundamentals of Spark Plasma Sintering, Net-Shaping and Size Effects," contributed presentation, Second International Symposium on High-Temperature Metallurgical Processing, San Diego Convention Center, San Diego, California, 3 March 2011 (with E. Olevsky, E. Khaleghi, C. Garcia, W. Bradbury, C. Haines, D. Martin, D. Kapoor).

"Spark Plasma Sintering of Tantalum Carbide," contributed presentation, Second International Symposium on High-Temperature Metallurgical Processing, San Diego Convention Center, San Diego, California, 3 March 2011 (with E. Khaleghi, E. Olevsky, Y.-S. Lin, W. Li, W. Bradbury).

"Powder Injection Molding of Metals, Ceramics, and Carbides," invited presentation, MIM 2011, International Conference on Metal Powder Injection Molding, Metal Powder Industries Federation, Hilton, Lake Buena Vista, Florida, 14 March 2011.

"Powder Injection Molding of Titanium Medical Devices and Implants," invited presentation, MIM 2011, International Conference on Metal Powder Injection Molding, Metal Powder Industries Federation, Hilton, Lake Buena Vista, Florida, 15 March 2011.

"Powder Injection Molding for Critical Applications," contributed presentation, MIM 2011, International Conference on Metal Powder Injection Molding, Metal Powder Industries Federation, Hilton, Lake Buena Vista, Florida, 16 March 2011.

"Markets, Applications, and Financial Aspects of Global Metal Powder Injection Molding (MIM) Technologies," contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 19 May 2011.

"Net-Shape Capabilities and Scalability of Conventional Spark Plasma Sintering and Free Pressureless Spark Plasma Sintering," contributed presentation, contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 19 May 2011 (with E. A. Olevsky, C. Garcia, E. Khaleghi, W. Li, Bradbury, W. Li, G. Brown).

"Infiltration Advances, Technical Assessments for Powder Metallurgy," contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 19 May 2011 (with W. Li, P. Rivest).

"Predictions of Tungsten Heavy Alloy Coarsening during Sintering," contributed presentation, International Conference on Tungsten, Refractory Metals, and Hardmaterials VIII, San Francisco, California, 20 May 2011 (with E. A. Olevsky).

"Titanium Powder Metallurgy - Merits of Press-Sinter and Metal Powder Injection Molding," special contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 20 May 2011.

"Gas-Assisted Powder Injection Molding: Mold Cavity Effects on Residual Wall Thickness," contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 20 May 2011 (with S. Ahn, H. Lee, R. Nambiar, D. Kim, S. W. Chung, S. J Park).

"Advances in W-Cu New Powder Systems," contributed presentation, International Conference on Tungsten, Refractory Metals, and Hardmaterials VIII, San Francisco, California, 21 May 2011 (with A. Bothate, W. Li, E. A. Olevsky, S. Daoush, S. Moustafa).

"Two Stages Spark-Plasma Sintering of W-Cu Alloys," contributed presentation, International Conference on Tungsten, Refractory Metals, and Hardmaterials VIII, San Francisco, California, 21 May 2011 (with W. Li, A. Bothate, E. A. Olevsky, S. Daoush, S. Moustafa).

"Powder Injection Moulding of Multi-Scale Titanium Parts - Micro Features and Surface Modification," special contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 21 May 2011 (with S. Ahn, E. Zarezna, P. Ewart, D. Zhang, S. J Park).

"Statistical Analysis of Green Strength Variation in Gas and Water Atomized 316L Stainless Steel Compacts," contributed presentation Powder Met 2011 International Conference on Powder Metallurgy and Particulate Materials, San Francisco, California, 21 May 2011 (with R. K. Enneti, S. V. Atre).

"Effect of Sintering Temperatures and Cooling Time on Physical and Mechanical Properties of Powder Injection Molded 316L Stainless Steel for Orthopedic Application," ICMAT 2011 - International Conference on Materials and Technology, Singapore, 17 June 2011 (with M. R. Raza, F. Ahmad, O. Mamat, M. Afin).

"Overview of Powder Metallurgy," Invited Seminar, Metal Powder Industries Federation Basic Powder Metallurgy Short Course, Pennsylvania State University, State College, Pennsylvania, 18 July 2011.

"Metal Powder Injection Molding," Invited Seminar, Metal Powder Industries Federation Basic Powder Metallurgy Short Course, Pennsylvania State University, State College, Pennsylvania, 18 July 2011.

"Powder Metal Injection Molding," Invited Short Course, Korea Institute Materials Science, Changwon, Korea, 26 August 2011.

"History of Sintering," Plenary Invited Presentation, International Conference on Sintering 2011, Jeju, Korea, 29 August 2011.

"Modeling and Simulation for Sintering Process," invited presentation, International Conference on Sintering 2011, Jeju, Korea, 29 August 2011 (with S. J Park, S. H. Chung, Y. S. Kwon, S. T. Chung, S. G. Kim).

"Fundamental Coupled Electrical, Thermal and Mechanical Analysis of Spark-Plasma Sintering," International Conference on Sintering 2011, Jeju, Korea, 30 August 2011 (with E. A. Olevsky, C. Garcia-Cordova, W. L. Bradbury, K. Haleghi, W. Li).

"Coarsening during Sintering," contributed presentation, International Conference on Sintering 2011, Jeju, Korea, 31 August 2011.

"Liquid Phase Sintering," invited TOBB seminar, College of Engineering, TOBB Economic and Technological University, Ankara, Turkey, 4 October 2011.

"Metal Powder Injection Molding – Processing and Design," invited keynote presentation, Sixth International Powder Metallurgy Conference, organized by the Turkish Powder Metallurgy Association, Middle East Technical University, Ankara, Turkey, 5 October 2011.
"Simulation and Modeling of Powder Injection Molding," invited keynote presentation, Sixth International Powder Metallurgy Conference, organized by the Turkish Powder Metallurgy Association, Middle East Technical University, Ankara, Turkey, 5 October 2011 (with S. J. Park, Y. S. Kwon, S. T. Chung, S. G. Kim).

"Consolidation of 42CrMo Steel by Spark Sintering," Sixth International Powder Metallurgy Conference, organized by the Turkish Powder Metallurgy Association, Middle East Technical University, Ankara, Turkey, 5 October 2011 (R. Yamanoglu).

"Experimental and Theoretical Analysis of Spark Plasma Sintering," presented at the 2011 Materials Science and Technology Conference, Columbus Convention Center, Columbus, Ohio, 18 October 2011 (with E. Olevsky, W. Bradbury, W. Li, C. Garcia)

"Integrated Electro-Thermo-Mechanical Analysis of Spark Plasma Sintering," invited presentation, 2011 Materials Science and Technology Conference, Columbus Convention Center, Columbus, Ohio, 18 October 2011 (with E. Olevsky, C Garcia, E. Khaleghi, W. Bradbury, W. Li).

"Powder Metallurgy Simulations: Press-Sinter and Injection Molding," invited presentation, 2011 Materials Science and Technology Conference, Columbus Convention Center, Columbus, Ohio, 19 October 2011 (with S. L. Ahn, S. H. Chung, S. T. Chung, S. J. Park, Y. S. Kwon).

"Dynamic Model for Coarsening during Sintering," 2011 Materials Science and Technology Conference, Columbus Convention Center, Columbus, Ohio, 20 October 2011.

"History of Sintering," invited presentation, Randall M. German Honorary Symposium, 141st Annual Meeting of the Metallurgical Society, Orlando, Florida, 12 March 2012.

"A Review of Alloying in Tungsten Heavy Alloys," invited presentation, invited presentation, Randall M. German Honorary Symposium, 141st Annual Meeting of the Metallurgical Society, Orlando, Florida, 12 March 2012 (with A. Bose, R. Sadangi).

"Multi-Scale Modeling and Experimentation on Liquid Phase Sintering Affected by Gravity: Preliminary Analysis," Materials Research in Microgravity Symposium, invited presentation, 141st Annual Meeting of the Metallurgical Society, Orlando, Florida, 14 March 2012 (with E. Olevsky, T. Young).

"Powder Injection Molding of Metals, Ceramics, and Carbides," invited seminar, MIM 2012, Metal Injection Molding Association, Metal Powder Industries Federation, San Diego, California, 19 March 2012.

"History of Powder Injection Molding," contributed presentation, MIM 2012, Metal Injection Molding Association, Metal Powder Industries Federation, San Diego, California, 20 March 2012.

"Sintering and Sintering Models," invited seminar, Adhesives Technology Division, Henkel Corp., Irvine, California, 5 April 2012.

"Densification and Distortion of Tungsten Alloys Using Low Sintering Temperatures," presented at PowderMet 2012, MPIF-APMI, Nashville, Tennessee, 11 June 2012 (with W. Li, E. Olevsky, T. Young, J. McKittrick, A. Ritchey).

"The Effect of Die Compaction Lubricants on Powder Characteristics: A Measurement System Analysis Study," presented at PowderMet 2012, MPIF-APMI, Nashville, Tennessee, 11 June 2012 (with R. L. Enneti, S. V. Atre).

"Phenomenological Observations and the Prospects for Predictive Computer Simulations," presented at PowderMet 2012, MPIF-APMI, Nashville, Tennessee, 12 June 2012.

"University-Industry Research," invited presentation, Metal Powder Industries Federation Management Program, Nashville, Tennessee, 12 June 2012.

"Probability Analysis on the Effect of Lubricant on the Green Strength Variation in Die-Compacted Samples," presented at PowderMet 2012, Metal Powder Industries Federation, Nashville, Tennessee, 13 June 2012 (with R.M. Enneti, Sundar V. Atre).

"Overview of Powder Metallurgy," invited seminar, Basic Powder Metallurgy Short Course, Penn State University, Metal Powder Industries Federation, State College, Pennsylvania, 23 July 2012.

"Metal Powder Injection Molding," invited seminar, Basic Powder Metallurgy Short Course, Penn State University, Metal Powder Industries Federation, State College, Pennsylvania, 23 July 2012.

"Relation between Density, Surface Area, and Grain Size during Sintering," presented at PM 2012 Powder Metallurgy World Congress, Yokohama, Japan, 16 October 2012 (with J.V. Lumar).

"Densification and Distortion of Tungsten Heavy Alloys Using Copper-Nickel-Manganese," presented at PM 2012 Powder Metallurgy World Congress, Yokohama, Japan, 16 October 2012 (with T. H. Young, W. Li, E. Olevsky, and D. Whychell).

"Development and Trends in North American PIM," Special Invited Seminar, PM 2012 Powder Metallurgy World Congress, Yokohama, Japan, 16 October 2012 (with A. Bose).

"Power Injection Molding – Forming Metals and Ceramics Like Plastics," Invited Seminar, Metallurgy Department and Materials Science and Engineering Department, University of Utah, Salt Lake City, Utah, 14 November 2012.

"Sintered Rare Earth Magnets – Jet Milling and Sintering," Invited Presentation, International Trade Commission, Washington, D.C., 17 December 2012.

"Powder Injection Molding – Metals, Ceramics, and Carbides," Invited One-Day Program, MIM 2013, Metal Powder Industries Federation, Lake Buena Vista, Florida, 4 March 2013.

"Metal Powder Injection Molding – A Long-Term Statistical Assessment," Presented at MIM 2013, Metal Powder Industries Federation, Lake Buena Vista, Florida, 5 March 2013.

"State of the Global PIM Industry," Invited Presentation, MIM 2013, Metal Powder Industries Federation, Lake Buena Vista, Florida, 5 March 2013 (with A. Bose).

"Time Collapses in First Prototype MIM Components," Presented at MIM 2013, Metal Powder Industries Federation, Lake Buena Vista, Florida, 6 March 2013 (with M. Brooks).

"Sintering Concepts - Supersolidus Liquid Phase Sintering," Invited Presentation, DuPont Electronics and Communications, Sunnyvale, California, 9 May 2013.

"Self-Similar Microstructure and Property Trajectories for Sintering," Invited Keynote Presentation, International Conference on Refractory Metals and Hard Materials, Hansee Seminar, Metallwerk Plansee, Reutte, Austria, 6 June 2013.

"Metal Powders: Trends in Applications," Invited Presentation, Poongsang Research and Development Center, Daejeon, Korea, 18 July 2013.

"Medical Devices and the Opportunities for Metal Powder Injection Molding," Invited Presentation, Second Biomedical Device Workshop, POSTECH Pohang University of Science and Technology, Pohang, Korea, 19 July 2013.

"Overview of Powder Metallurgy," Invited Presentation, Metal Powder Industries Federation, Basic Short Course, Penn Stater Hotel, Pennsylvania State University, State College, Pennsylvania, 12 August 2013.

"Metal Powder Injection Molding," Invited Presentation, Metal Powder Industries Federation, Basic Short Course, Penn Stater Hotel, Pennsylvania State University, State College, Pennsylvania, 12 August 2013.

"Metal Powder Injection Molding – Historical Developments, Current Statistical Assessment, and Future Trends," Invited Keynote Presentation, Second International Conference on Powder Metallurgy in Asia – AFMA 2013, Asian Powder Metallurgy Association, Xiamen, China, 4 November 2013.

"Powder Injection Molding Tutorial," invited presentation, MIM 2014 International Conference on Injection Molding of Metals, Ceramics, and Carbides, Metal Powder Industries Federation, Long Beach, California, 24 February 2014.

"Powder Injection Molding Global Market Trends," presented at MIM 2014 International Conference on Injection Molding of Metals, Ceramics, and Carbides, Metal Powder Industries Federation, Long Beach, California, 25 February 2014 (with S. V. Atre).

"A Review of Lower Sintering Temperature Tungsten Alloys," presented at the International Conference on Tungsten, Refractory and Hardmaterials, Metal Powder Industries Federation, Orlando, Florida, 19 May 2014.

"Microstructural Evolution of Tungsten Heavy Alloys: A Quenching Study," presented at the International Conference on Tungsten, Refractory and Hardmaterials, Metal Powder Industries Federation, Orlando, Florida, 20 May 2014 (with R. Bollina, P. Suri, and R. J. Enneti).

"Identification of the Common Densification Pathway for Metal Powder Compaction, Sintering and Pressure-Assisted Densification," presented at 2014 World Congress on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Orlando, Florida, 22 May 2014.

"Global Market Performance of Powder Injection Molding," presented at 2014 World Congress on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, Orlando, Florida, 22 May 2014 (with S. V. Atre).

"Sintered Nanoscale Structures – The Need for Novel Processing and Compositions to Realize Novel Properties," invited keynote presentation, ISNNM2014, Thirteenth International Symposium on Novel and Nano Materials, AGH University, Krakow, Poland, 2 July 2014.

"Low Temperature Liquid Phase Sintered Tungsten Alloys for Critical Microgravity Trials," presented at the International Conference on Sintering 2014, Dresden, Germany, 25 August 2014 (with E. A. Olevsky, T. H. Young).

"Modeling Linking Microstructure Evolution to Densification in Sintering and Pressure-Assisted Sintering," invited keynote presentation, International Conference on Sintering 2014, Dresden, Germany, 25 August 2014.

"Powder Injection Molding," invited one day seminar, MIM 2015 International Conference on Injection Molding of Metals, Ceramics, and Carbides, Metal Powder Industries Federation, Tampa, Florida, 23 February 2015.

"Opportunities in Particulate Composites," contributed presentation, MIM 2015 International Conference on Injection Molding of Metals, Ceramics, and Carbides, Metal Powder Industries Federation, Tampa, Florida, 25 February 2015.

"The Gravitational Role in Liquid Phase Sintering," contributed presentation, Powdermet 2015 International Conference on Powder Metallurgy and Particulate Materials, Metal Powder Industries Federation, San Diego, California, 18 May 2015.

"Sintering of bi-porous titanium dioxide scaffolds: Experimentation, modeling, and simulation," invited presentation, Materials Science and Technology Conference, American Ceramic Society, Columbus, Ohio, 7 October 2015 (with W. Li, M. M. Porter, E. A. Olevsky, J Mol ittrick).

"Modeling of Gravitational Effects on Particle Settling and Shape Distortion during Liquid Phase Sintering of Tungsten Heavy Alloys," presented at the 2016 Annual Meeting, Materials Research in Reduced Gravity Symposium, The Minerals, Metals, and Materials Society, Nashville, TN, 17 February 2016 (E. A. Olevsky, J Alvarado-Contreas, R. M. German).

"Overview of Powder Injection Molding – Metals, Ceramics, and Cemented Carbides," invited presentation, PIM Symposium, Metal Powder Industries Federation, Irvine, CA, 7 March 2016.

"Debinding Theory and Practice Relevant to Dimensional Control," contributed presentation, MIM 2016 Conference, Metal Powder Industries Federation, Irvine, CA, 8 March 2016.

"Sintering mechanism of nanoscale copper powder: effects on the crystalline misalignment," 2016 Spring Conference of Korean Powder Metallurgy Institute, Yungjin Korea, 31 March 2016 (Y. Seong, Y. Lim, S. Im, S.-G. Im, R.M. German, S. Lim, H. Lim, and S. Park).

"Powder Injection Molding – Metals, Ceramics, and Cemented Carbides," invited one day tutorial, 10th Annual China Powder Metallurgy Conference, Everbright Convention Center, Shanghai, China, 26 April 2016.

"MIM and the Combined Technology-Economic Situation for High Volume Production," invited presentation, 10th Annual China Powder Metallurgy Conference, Everbright Convention Center, Shanghai, China, 27 April 2016.

"Sintering Concepts and Applications," invited two day seminar, Hewlett Packard, Research Center, Palo Alto, California, 11 and 12 January 2017.

"Powder Injection Molding of Metals, Ceramics, and Cemented Carbides," invited one day tutorial, Metal Powder Industries Federation, Orlando, Florida, 27 April 2017.

CERTIFICATE OF SERVICE

The undersigned attorney certifies on June 28, 2018 that copies of the Declaration of Randall M. Gerrnan, Ph.D. in support of Owens-Illinois's Notice of Removal was served under Federal Rule of Civil Procedure 5 by electronic means to all counsel of record.

MARON MARVEL BRADLEY ANDERSON & TARDY, LLC

By: /s/ Chad D. Mountain
Chad D. Mountain, Esquire